1939.

QUEENSLAND.

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THIRTY-NINTH ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS.

REPORT OF THE DIRECTOR

TO

THE HON. THE SECRETARY FOR AGRICULTURE AND STOCK

(*As required by "The Sugar Experiment Stations Acts*, 1900 *to* 1938").

PRESENTED TO PARLIAMENT BY COMMAND.

BRISBANE:
BY AUTHORITY: THOMAS GILBERT HOPE, ACTING GOVERNMENT PRINTER.

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THIRTY-NINTH ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS.

Director's Report.

TO THE HONOURABLE THE SECRETARY FOR AGRICULTURE AND STOCK.

SIR,—I have the honour to submit the Thirty-ninth Annual Report of The Bureau of Sugar Experiment Stations, covering the period 1st July, 1938, to 30th June, 1939.

H. W. Kerr.

Director.

Brisbane, 29th September, 1939.

General.

Growing conditions for the 1939 cane crop were characterised by an abnormally dry spring and early summer, followed by generally favourable late summer and autumn rains. The season must therefore be classed as a little better than average.

In the far Northern areas of the State, winter rains during 1938 were favourable for good germinations of the young crop, but from that time until the end of the year little useful rain for growth promotion was experienced. Then followed a heavy wet season, which continued into May. Although many areas reported record heavy falls, surprisingly little damage was done to crops, though a number lodged early.

The Central districts experienced a somewhat similar season, in that the spring rains were deficient, while a prolonged drought period during the early summer months exercised a severe check on growth. But the sequence of favourable rains from late January until June enabled the crop to make up the leeway, so that the crop to be harvested is above normal dimensions.

In the Southern areas the season was one of rainfall deficiency practically throughout. The winter rains of 1938 reacted favourably towards the young cane and early ratoons, but the dry spring and early summer were abnormally severe, and late rains alone were responsible for such active growth as was recorded. The heavy tonnages of cane available for harvest in these parts, during 1939, must then be attributed largely to the excessive area of crop allowed to stand over from the previous season.

Report of Director—continued.

Crop Yield, 1938—Crop Estimate, 1939.

The following table shows the individual mill crushings for the 1938 season, and the estimated crops available for harvest during 1939 :—

1938 Crushing.	Mill.	1939 Estimate.
Tons.		Tons.
98,361	Mossman	133,000
213,715	Hambledon	250,000
249,246	Mulgrave	286,000
272,230	Babinda	270,000
199,229	Goondi	195,000
265,508	South Johnstone	286,361
180,588	Mourilyan	195,000
291,486	Tully	306,868
255,544	Victoria	311,000
249,520	Macknade	280,000
95,603	Invicta	108,000
184,892	Poineer	189,170
213,331	Kalamia	223,000
261,220	Inkerman	263,860
195,016	Proserpine	150,000
84,394	Cattle Creek	85,000
196,588	Racecourse	215,000
162,295	Farleigh	196,000
96,212	North Eton	110,000
168,179	Marian	185,000
187,460	Pleystowe	200,000
184,976	Plane Creek	205,000
83,310	Qunaba	90,000
158,399	Millaquin	240,000
176,100	Bingera	285,000
139,749	Fairymead	294,104
50,125	Gin Gin	65,000
215,206	Isis	*200,600
33,027	Maryborough	*55,000
51,388	Mount Bauple	42,000
110,366	Moreton	150,000
15,668	Rocky Point	13,000
2,654	Eagleby	1,800
5,342,085	Total	**6,079,763**

* Since the conclusion of the 1938 crushing season, cane lands of the Pialba district have been transferred from Isis to Maryborough Mill.

Estimates of Sugar Yield, 1939 Crop.

The preliminary estimate of the cane crop which will be available for harvest in Queensland during the 1939 season is 6,079,763 tons. This is about 600,000 tons higher than the estimated figures prepared for the 1938 crop, and is due in part to two causes: (*a*) growing conditions for the crop have been rather uniformly favourable throughout all areas, and doubtless the available crop is the largest produced in Queensland; (*b*) mills have this year presented estimates which embrace all cane that will be fit to harvest during 1939, whereas in previous years many have forecast only that quantity which would definitely be harvested.

Report of Director—continued.

From the cane available, some 885,000 tons of 94 n.t. sugar could probably be manufactured, if all were harvested. But in view of the necessity for controlling manufacture within the limits of the available market, both in Australia and abroad, it appears that sugar production will attain a figure approximating to that to be acquired in terms of the Proclamation of 1939—that is, the newly gazetted mill peaks *plus* 12 per cent. where cane is available for manufacture, or some 800,000 tons.

In addition, it is estimated that some 38,000 tons of 94 n.t. sugar will be manufactured by the three New South Wales mills, giving a total Australian production of sugar from cane of approximately 838,000 tons.

STATISTICS OF THE 1938 CROP.

The yield of raw sugar in Queensland for the 1938 crop was *778,136 tons of 94 n.t. This is a further record, exceding that of 1937 by some 15,000 tons.

The following table shows the geographical distribution of the crop for the past five years, as between "northern" and "southern" cane districts:—

Sugar Production, 1934-38.

District.	1934.	1935.	1936.	1937.	1938.
	Tons.	Tons.	Tons.	Tons.	Tons.
North of Townsville	233,457	258,958	333,615	373,692	328,301
South of Townsville	379,113	351,368	410,646	389,633	449,835
Total	612,570	610,326	744,261	763,325	778,136

The sugar manufactured in the "southern" areas is far in excess of the previous high figure, that of 1936. It is of interest to compare trends in production during the past years (*see* Fig. 1) which demonstrate clearly the manner in which production in the central and southern mill areas has progressed with the planting of improved sugar-cane varieties, the elimination of losses from disease, and the adoption of modern methods of intensified production. In studying these figures it must be borne in mind also that, during recent years, substantial quantities of cane have also been allowed to remain unharvested in the southern areas.

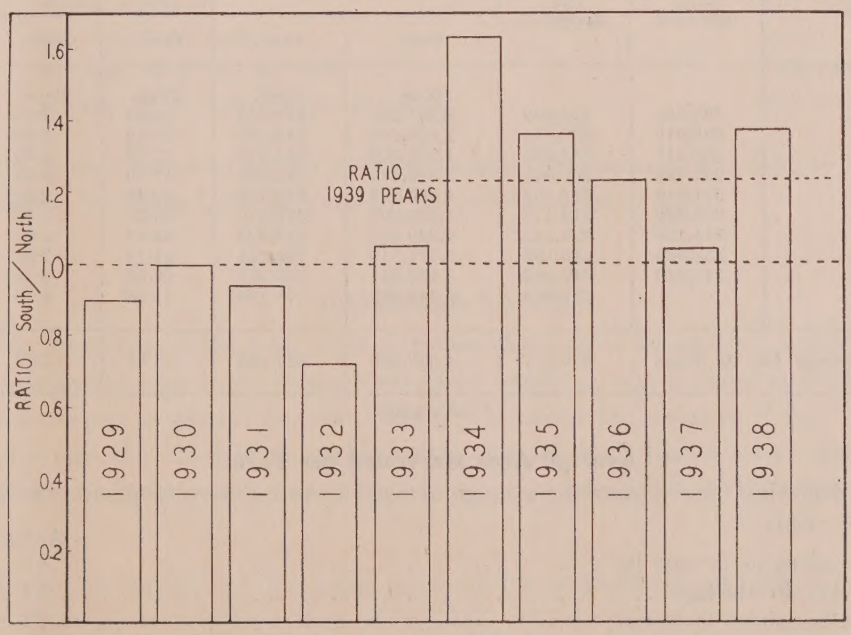

FIG. 1.—Graph showing the manner in which the areas south of Townsville have increased their production in recent years. The major portion of the sugar crop has come from these districts during the past six years.

* This is slightly in excess of the figure quoted on page 6, as it includes "local" sales which are additional to that acquired by the Sugar Board.

Report of Director—continued.

Area Harvested and Acreage Yield.

The total area harvested for milling purposes in 1938 was 251,064 acres, which is some 1,400 acres greater than that of the previous season. The acreages under plant, ratoon, and standover cane were as follows:—

	Acres.
Plant cane	97,119
Ratoon cane	136,095
Standover cane	17,850
Total	251,064

The yield of cane per acre crushed was 21·3 tons, while the average sugar yield was 3·10 tons per acre. Both these figures establish new records for Queensland. The yield of sugar per acre has now exceeded 3 tons for three consecutive years.

The following were the yields of cane and sugar per acre in the respective sugar districts:—

Acreage Yields by Districts.

District.	Tons Cane per acre.	Tons 94 n.t. Sugar per acre.
Mossman–Ingham	22·58	3·26
Lower Burdekin	26·73	4·17
Proserpine	18·16	2·85
Mackay–St. Lawrence	16·42	2·53
Bundaberg–Gin Gin	23·97	2·67
Maryborough–Childers–Gympie	20·20	2·67
Nambour–Beenleigh	24·18	3·30
State Average	21·28	3·10

The following table gives the crop statistics for Queensland for the past ten years:—

Table showing Acres Cultivated and Harvested, Yields of Cane and Sugar, Acre-Yields, and Quality of Cane, 1929-1938.

Year.	Acres Cultivated.	Acres Harvested.	Total Yields.		Yields Per Acre.		Tons Cane to 1 ton Sugar.
			Cane.	Sugar.	Cane.	Sugar.	
			Tons.	Tons.	Tons.	Tons.	Tons.
1929	291,660	214,880	3,581,265	518,516	16·67	2·41	6·91
1930	296,070	222,044	3,528,660	516,783	15·89	2·33	6·83
1931	309,818	233,304	4,034,300	581,276	17·29	2·49	6·94
1932	291,136	205,046	3,546,443	514,085	17·30	2·51	6·90
1933	311,910	228,154	4,667,028	638,734	20·46	2·80	7·31
1934	303,926	218,426	4,269,991	612,570	19·56	2·80	6·97
1935	314,700	228,515	4,220,267	610,326	18·47	2·67	6·92
1936	338,686	245,152	5,171,516	744,261	21·10	3·04	6·94
1937	348,840	249,683	5,132,934	763,325	20·56	3·06	6·73
1938	*	251,064	5,342,085	778,136	21·28	3·10	6·87
True Average for 10 Years	229,627		4,349,429	627,852	18·94	2·73	6·94

* Not available.

Average Area Harvested per Farm.

The following figures show the average acreage *harvested* by cane planters in Queensland for the 1938 crop:—

	Acres.
Cairns to Townsville	47
Ayr to Mackay	33
Bundaberg to Bauple	20
Nambour to Beenleigh	8
State average	31

The average area harvested per planter was 31 acres, which is one acre higher than that of the previous year.

Report of Director—continued.

Molasses Produced.

The following figures supplied by the Government Statistician show the manner in which the molasses produced in 1938 was disposed of:—

	Gallons.
Sold to distilleries	8,275,887
Burnt as fuel	3,748,590
Used or sold for feed	4,237,196
Sold or used for other purposes	232,049
Used as manure	3,293,543
Run to waste	498,926
Total	20,286,191

The 1938 figures show a further increase in the quantity of the by-product utilized by distilleries, while a reduction is recorded in the quantity used by the mills as fuel. This reflects the benefits accruing from improved furnace design and steam economy which are being accomplished. The amounts used as manure and stock feed show little change from the 1937 data, while the quantity run to waste has also varied but slightly.

MAFFRA BEET FACTORY.

The following data in respect of the Maffra Sugar Factory, Victoria, are supplied through the courtesy of the Manager:—

Crop Yields, 1939 Season.

Area harvested	2,454 acres
Beet purchased	13,454 tons
Beet sliced	12,755 tons
Average sugar content	14·83 per cent.
Sugar produced	1,507 tons
Price paid for beet	40/-
Average yield beet per acre	5·48 tons
Average yield refined sugar per acre	0·61 tons

The marked reduction in beet yields and sugar manufactured therefrom is in consequence of the drought conditions prevailing during the growth period.

1938 SUGAR VALUES.

The proportion of the 1938 sugar crop manufactured in Queensland, which was required for consumption and use in the Commonwealth of Australia, was declared at 55·3833 per cent., and that for export at 44·6167 per cent. These proportions are exclusive of the "excess" sugar produced by mills in excess of their allotments under the Peak Year Scheme. The excess sugar produced for the 1938 season was 163,943 tons, as compared with 183,869 tons for the 1937 crop.

The price payable for the sugar required for consumption and use in Australia was declared at £24 per ton of 94 net titre, as for 1937. The net value per ton of 94 net titre sugar sold abroad was £8 4s. 3d., which is 1s. 9d. per ton lower than the 1937 figure. The average price paid to those Queensland mills which did not produce "excess" sugar was £16 19s. 1d. per ton, compared with £17 11s. for the previous season. The average value of *all* sugar was £15 2s. 2d., which is the lowest recorded since 1914.

Report of Director—continued.

The following table summarises production and consumption figures and sugar values since the year 1924, when the first large surplus was produced:—

Year.	Total Sugar Production at 94 n.t.	Tons Sugar Exported.*	Average Australian Price.	Average Export Price.	Average Price, No. 1 Pool Sugar.	Average Price, *all* Sugar.
	Tons.	Tons.	£	£	£	£
1924	409,136	74,000	26·0	21·0	26·0	26·0
1925	485,585	219,000	26·5	11·3	19·5	19·5
1926	389,272	74,777	26·5	14·9	24·5	24·5
1927	485,745	152,384	26·5	12·1	22·0	22·0
1928	520,620	186,703	26·5	10·5	20·9	20·9
1929	518,516	197,000	27·0	9·9	20·3	20·3
1930	516,783	203,605	27·0	8·3	19·7	†19·5
1931	581,276	291,802	27·0	9·4	18·3	18·0
1932	514,027	189,733	25·0	8·3	19·3	18·8
1933	638,734	305,687	24·0	8·0	17·2	16·2
1934	612,570	277,336	24·0	7·6	16·5	15·5
1935	610,326	298,202	24·0	7·9	16·9	16·2
1936	744,261	409,400	24·1	7·95	17·1	15·2
1937	762,794	430,523	24·0	8·3	17.55	15·3
1938	776,810	443,386	24·0	8·2	16·95	15·1

* Bagged sugar. † Peak Year Scheme first operated in 1930.

Total Value, 1938 Sugar Crop.

The total value of the 1938 Queensland crop was £11,738,000—an all-time record.

ECONOMIC REVIEW.

The most important event during the past year, in so far as the domestic economy of the sugar industry is concerned, was the appointment by the State Government of a Royal Commission to enquire into certain aspects of the industry, notably in respect of the incidence of the 1929 Peak Year Scheme; and to consider the desirability of reviewing the individual mill quotas fixed at that time, in relationship both to their absolute and relative magnitudes. The Report of the Commission was submitted to the Hon. the Premier on the 27th April, 1939.

The Government gave early consideration to the recommendations of the Commission, and in issuing the annual Proclamation, for the acquisition of the 1939 crop, adopted the new mill quotas as advanced in the majority report. These provide for the allocation of 737,000 tons of 94 n.t. sugar, which at the present time represents the aggregate of home consumption quota *plus* the Queensland proportion of the annual quota for export as determined by the International Sugar Council. Doubtless this is the most important feature of the Report; for it definitely limits the annual production permitted in each mill area: formerly, the mill was allowed to crush *ad lib.*, the only deterrent being the question of average price for its sugar.

The Report of the Commission was generally well received by the industry, which recognised that these gentlemen had discharged a difficult task with considerable merit. As the redistribution of quotas could not add anything directly to the gross income of all producers, it was necessary that some mill areas should be benefited while others were adversely affected. A measure of dissatisfaction has been voiced by a few districts which, naturally, considered they have not been justly treated; but there appears to be unanimity in the view that the adoption of maximum production quotas will provide the basis for stability in production policy which has been lacking heretofore. While not applauding a policy of production restriction and what it implies, one must agree that it is futile to continue in the production of something which cannot be marketed. The poignancy of the position is emphasised by the fact that the 1939 harvesting season opens with an all-time record crop of cane for treatment by

Report of Director—continued.

the mills. On the existing basis, areas of crops of varying dimensions would have to remain in the fields, and be left to the mercy of the environment. While in some districts a proportion of standover cane is actually regarded as a welcome safeguard against seasonal variations, in others the incidence of climate and pests, with unsuitable cane varieties, may render such a policy most hazardous. In fact, such a crop might become a distinct liability, as the farmer would be involved in expense in disposing of the spoiled cane preparatory to replanting the land.

In order to make the control system complete, it is generally considered that the mill quota must be allotted amongst the suppliers of cane to the mill in a manner which would assure an equitable distribution to each and eliminate the constant uncontrolled competition between canegrowers, which has featured the expedients adopted in certain areas in past years. The Commission recommended to the Government that legislation be introduced to permit of farm production agreements of this nature, and it is understood that steps will be taken. during the forthcoming Parliamentary session, to implement the recommendation.

It is fortunate for the industry in its present plight that short supplies of quotas allotted by the International Council to certain countries enables an announcement to be made that, for the quota year 1938-39, an increased allotment has been given to Australia, which will permit of the export of 455,444 long tons of sugar for the period. Furthermore, the quota for the year 1939-40 was fixed at 415,616 long tons. In view of this rather unexpected relief, the 1939 proclamation was able to provide for an increase in basic quotas to those mills with excess cane, enabling them to manufacture an additional 7 per cent. of sugar at export parity.* As a consequence, the only areas in which any substantial quantity of excess cane will remain unharvested are those of the Mackay and Bundaberg districts.

As was indicated earlier in this Report, the heavy tonnage of cane available for manufacture during 1939 is due largely to a reasonably satisfactory growing season in all cane areas of the State. While no area was unduly favoured in this respect, it is true that none suffered from excessively dry conditions. But it is well to bear in mind that if all districts should be favoured in any year by abnormally good growing conditions, the equivalent of a million tons of sugar might well be produced. Such would, of course, be a calamity, unless some unfortunate circumstances combined to produce a shortage in other major sugar-producing countries. Truly the way of the sugar grower is a difficult one, however he may attempt to lay his future plans; but it would appear wisest to take a rather conservative viewpoint of the future, and set his course accordingly.

It is pleasing to record that the recent progress in production efficiency, to which attention has been directed in recent reports, has been sustained. For each of the past three seasons, the average production of sugar per acre has exceeded 3 tons—while for 1938 the average was a new high of 3·10 tons. This is undisputed evidence of the appreciation by the industry that man-power efficiency is by far the largest item contributing to costs of production, and that costs of fertilizers and irrigation water are of major importance only when the man-tonnage efficiency reduces labour costs per unit of production to a minimum.

The Bureau has consistently pursued a policy which is calculated to assist the industry in this respect. The production and importation of new cane varieties each year contribute something better than was available heretofore; the elimination of losses from pests and diseases, and the more rational use of artificial manures enable the grower to reap a better return for his labours and expenditure; and the promotion of improved recoveries in the factory, with the concomitant reduction of losses from various causes, tends to a manufacturing efficiency equal to that of the most advanced sugar-producing countries.

It is considered, moreover, that the lot of the canegrower could be improved, in many areas, not by attempting to produce more cane per farm, but by intensifying production per acre, and devoting at least a portion of the land to some other form of agriculture which would assure a reasonable return, while assisting in the promotion of a sounder and more permanent agricultural system. The Queensland sugar industry can rightly claim to have made more technical and economic progress than probably any other Australian primary industry; but it also recognises that the limit has not been reached.

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*This figure was subsequently increased to 12 per cent.

Work of the Bureau.

The detailed reports of the officers in charge of the several Divisions will be found in the ensuing pages of this Report. The following comments summarise some of the more important general aspects of the activities of the Bureau for the year under review:—

Advisory Board.

Meetings.

During the year, four meetings of the Board were held—on the 21st August and the 9th November, 1938, and 3rd March, 1939, in Brisbane, and on the 7th June, 1939, at Meringa.

Following the failure of the sugar organisations to agree upon a joint nomination for Southern growers' representative, Mr. C. W. Thiele, of Bundaberg, was appointed by the Minister to fill the vacancy. Mr. N. H. Wellard was elected Deputy Chairman, and he presided over the August, March, and June meetings in the absence of the Hon. the Minister.

Staff.

The Board devoted attention to the filling of the vacancy caused by the resignation of Ir. J. Eigenhuis, and also to the appointment of suitable juniors as cadets in the agricultural branch of the service. The response to the advertisements calling applications for the position of Mill Technologist was disappointing, and the Board was unable to make a suitable selection from those offering. One cadet (Mr. N. McD. Smith) was selected and appointed early in 1939, while it was anticipated that a second junior would be selected before the close of the year.

It is proposed by the Board that a further effort be made to secure the services of a competent Mill Technologist to take control of that branch.

Disease Control.

This phase of the work of the Bureau was constantly before the notice of the Board, and the year has been a most important one in this respect. It witnessed the enactment of the legislation amending the Sugar Experiment Stations Acts, so as to bring the control of cane disease directly under the Bureau. This has now been implemented to provide the necessary local facilities, and it must be agreed that the Act as it now stands enables the job to be tackled in an effective manner such as was not possible heretofore. The creation of Disease Control Boards in areas where such were necessary is rapidly bringing disease under control, and seems to provide the answer to the problem of eliminating this as a cause of substantial economic waste.

New Cane Varieties.

The Board recognises the significance of resistant cane varieties as a major factor in disease control, and has endorsed the project of varietal introduction and seedling propagation as a means of achieving this purpose.

Farmers' Sugar School.

During January, 1939, a very successful school was conducted at Gatton College, for the purpose of providing a sugar agricultural course and tractor school for young canegrowers and canegrowers' sons. The success which attended this initial effort warrants a continuance of the scheme, and it is hoped that, with obvious modifications, it might become an annual event.

Publications.

The Board has also pursued a policy of providing full educational facilities for canegrowers through the medium of the Bureau publications. The Board decided that steps should be taken for the early issue of the Cane Growers' Handbook, which should prove an asset to farmers interested in learning all they can of modern agricultural methods. A copy of this handbook will be issued to each canegrower in Queensland, early in the next financial year.

The Technical Communications and Cane Growers' Quarterly Bulletins are each year more keenly sought by those engaged in the industry.

Farmers' Field Days.

Farmers' Field Days were conducted during June on each of the Sugar Experiment Stations. Excellent attendances of growers were recorded at Bundaberg and Mackay, but it is regretted that the Northern farmers do not exhibit a greater interest in their regional Experiment Station. These annual functions provide an excellent opportunity for farmers to see what the Stations are doing, and to hear informative addresses from the technical officers of the Bureau.

Work of the Bureau—continued.

Power Alcohol.

This is a subject in which the Board has taken a keen interest, and it was pleased to learn that the Government had permitted the Director to serve as the sugar industry representative on the Power Alcohol Sub-committee of the Liquid Fuel Standing Committee appointed by the Commonwealth Government. Though the sub-committee's recommedations were not adopted, it is felt that, more than ever, the establishment of an alcohol distillery to deal with surplus cane and by-products is worthy of the keenest support by all concerned. Only in this way could the real possibilities of such a project be fully explored.

Levy.

The levy for the year 1939-40 was fixed at ¾d. per ton of cane, as in the previous year.

Queensland Society of Sugar Cane Technologists.

The members of the Bureau staff recognise in the Society a sister organisation worthy of every assistance they can give it. The 1939 Conference held at Ayr was presided over by the Director (Dr. H. W. Kerr), while interesting and informative papers were presented by several members of the staff. At this Conference, the delegates to the International Congress held in Louisiana in October, 1938, presented their reports and conducted very useful discussions. The excellent attendance of farmers at the agricultural sessions was most encouraging.

Staff Changes.

During the year Miss M. Wyllie, who had served as chief clerk-typist in the Brisbane office, resigned her position. Miss Wyllie was associated with the Bureau throughout the period of expansion, and it is desired to place on record our keen appreciation of her loyal and meritorious service through a most difficult period. She is succeeded by Mr. J. R. Winders, who has now assumed control of the clerical staff.

The appointment of Mr. N. McD. Smith as cadet to the field staff will serve to relieve the pressure on present officers somewhat, but further appointments are necessary to fully satisfy the demands on the services of this branch, which must be regarded as one of the most important links in the chain of agricultural research.

Experiment Stations.

The policy of bringing the regional stations to a higher state of efficiency by providing more adequate facilities for their work was continued during the year, A new hothouse for seedling propagation was constructed at Mackay, and a spray irrigation system for young seedlings was installed. At Meringa, a further implement storage shed and a modern insectary were constructed, while at Bundaberg a new residence was built and attention given to permanent Station improvements. With the extension of electricity supply to the districts, steps will now be taken to modernise the laboratory power and heating system.

Publications.

The following numbers of the Technical Communications were issued during the financial year:—

1938 Series—

- No. 4—"Milling Tests, 1937 Season," by G. H. Jenkins.
- No. 5—"The Analysis and Sampling of Final Bagasse," by G. H. Jenkins.
- No. 6—"Clarification Tests, 1937 Season," by E. R. Behne and G. H. Jenkins.
- No. 7—"Volume and Surface Relationships of Raw Sugar," by L. Drinnen.
- No. 8—"The Separation of Molasses from the Sugar Crystals in the Fugals," by E. R. Behne.
- No. 9—"The Laboratory Determination of Soil Fertility," by H. W. Kerr and C. R. von Stieglitz.
- No. 10—"Some Studies in Soil Sampling Technique," by H. W. Kerr and C. R. von Stieglitz.
- No. 11—"The Determination of Fibre in Cane. II.," by H. W. Kerr.

1939 Series—

- No. 1—"Clarification Tests, 1938 Season," by E. R. Behne.
- No. 2—"Automatic Liming Control," by E. R. Behne.
- No. 3—"Alternate Hosts of *B. Vasculorum*, The Causal Agent of Gumming Disease of Sugar Cane," by C. G. Hughes.
- No. 4—"The Fugalling Process and High Speed Centrifugals," by E. R. Behne.

"The Cane Growers' Quarterly Bulletin" also appeared regularly.

Work of the Bureau—continued.

Balance Sheet.

STATEMENT OF RECEIPTS AND DISBURSEMENTS FROM 1ST JULY, 1938, TO 30TH JUNE, 1939.

Receipts.	£	s.	d.	Disbursements.	£	s.	d.
To Balance, 1st July, 1938	17,975	13	2	By Salaries	9,801	2	0
„ Assessments	16,694	14	9	„ Contingencies—Head Office	9,292	8	7
„ Endowment	7,000	0	0	„ Bundaberg Contingencies	2,594	18	11
„ Bundaberg Station	951	16	0	„ Mackay Contingencies	2,075	10	4
„ Mackay Station	607	7	10	„ Meringa Contingencies	1,878	10	1
„ Meringa Station	445	8	7	„ Balance, 30th June, 1939	18,114	15	6
„ Sundries	82	5	1				
	£43,757	5	5		£43,757	5	5

C.C.S. Formula.

For the benefit of overseas readers of this report, we would point out that the measure of available sugar in cane (so-called Commercial Cane Sugar or C.C.S.) is defined as follows :—

$$\text{C.C.S. in juice} = \text{Brix in juice} - \frac{\text{Impurities in juice}}{2}$$

and C.C.S. in cane is calculated by the formula :—

$$\text{C.C.S.} = \frac{3P}{2}\left(1 - \frac{5 + F}{100}\right) - \frac{B}{2}\left(1 - \frac{3 + F}{100}\right)$$

where—P = pol in first expressed juice
B = brix in first expressed juice
F = fibre in cane.

Division of Soils and Agriculture.

Staff.

It was decided by the Advisory Board to appoint a further three cadets to the agricultural staff (extension service) during the current financial year. The policy pursued in recent times—and one which appears to possess merit—is to select suitable candidates on the completion of their diploma course at an approved agricultural college. One such cadet was appointed early in 1939, and it is anticipated that a further suitable appointee will be available in the spring.

With the continued increase in the duties imposed on this branch of the service, due largely to the recent spread of disease, the need for further additions of suitable young officers is indicated.

Mr. L. C. Home, who served as part-time laboratory assistant to the Mill Technology Branch, also assisted the chemists in the Bris bane laboratory with routine soil analytical work as opportunity offered.

Extension Work.

The farm experimental work—involving the determination of plantfood deficiencies as well as the testing of new cane varieties—increases from year to year. It is safe to say that much of the conviction accompanying experimental results reported to canegrowers in recent years lies in the fact that the trials are conducted under actual farm conditions.

Of the seedling canes raised annually on the three Experiment Stations, the survivors of the final selection ensure an adequate volume of new material to be taken into new field trials instituted each year. Similarly, those canes which give a satisfactory account of themselves are then planted over a wide series of experimental-propagation plots.

During the current year, plans for the release of Q. 10 (in North Queensland), Q. 20 (Mackay and Burdekin districts), and Q. 25 (Southern areas) were finalised. Supplies of these three canes will be available for such plantings during the spring of 1939.

Soil Testing and Surveys.

The progressively larger number of soil samples submitted each year for analytical purposes demonstrates the appreciation of this service by canegrowers. Nevertheless, the number of samples received represents only a fraction of what might be transmitted, and we have no hesitation in stating that many farmers are still content to carry on their fertilizer practices without due regard for the specialised requirements of their lands. As a result, much money is still expended unwisely in the purchase of artificial manures. On the other hand, a number of farmers have still to learn the value of these materials, and we are continually receiving for test purposes soil samples which show what happens to cane lands in which the plant-food supply is neglected.

The general survey work, initiated last year in the Innisfail district, has been continued during the autumn months. It will require some four years before the job is completed, as only plant cane blocks are sampled annually; but it promises to provide some very interesting and valuable information regarding soil fertility variations over small areas.

Sugar Technologists' Conference.

The Conference of the Society was held in Ayr during March, 1939, and the agricultural staff of the Bureau was well represented. In addition to papers presented by the Director and Assistant Director, a very interesting illustrated lecture was given by Mr. N. J. King on his recent visit to Hawaii and the United States of America. Mr. King was selected as the agricultural delegate by the Society to the Conference of the International Society of Sugar Cane Technologists, held in Louisiana late in 1938.

The attendance of canegrowers at the Ayr Conference was exceedingly good. Doubtless these annual gatherings provide local growers with an excellent opportunity of keeping in touch with the work of the Society.

Legume Bacteria.

The service instituted last year, in co-operation with the Division of Pathology, of providing legume cultures to canegrowers wishing to inoculate their seed before sowing, was keenly sought. The amount of inoculum distributed would permit of the treatment of seed sufficient for some 2,000 acres of fallow land. Good reports are to hand regarding the value of the treatment, and a continuance of the scheme should ensure the inoculation of a large proportion of cane lands with an efficient strain of rhizobium.

Division of Soils and Agriculture—continued.

New Legume Species.

Extensive tests have been conducted by the Bureau, on both farms and Experimental Stations, in an attempt to obtain leguminous species superior to the present standards, for green manurial purposes. The chief desiderata of such are drought resistance, resistance to insect pests, and long growing season.

Of those tested during the past year *Crotalaria goreensis* (now named Gambia pea) and *C. anagyroides* possess distinct promise. The former will be widely distributed in small quantities during the coming spring, so that farmers in all areas may have a chance to test it. Supplies of anagyroides have been obtained from New Guinea, and trials will be confined to our Experiment Stations for 1939.

Seedling Propagation.

The detailed report of the Committee responsible for this important phase of Experiment Station work will be found elsewhere in this Report. While entailing a large amount of tedious effort this aspect of the work of the Bureau promises to confer substantial benefits on the industry. At the present time, the demand for a satisfactory standover variety for the Central and North districts of the State is pressing. Until such is available, the present value of crop production is likely to cause growers in those parts a deal of worry and anxiety.

Alternative Crops.

It is the policy of the Bureau to urge the necessity for seeking alternative avenues of income which might be followed by canegrowers, as the necessity for controlling areas under cane becomes more evident. Though it has not been possible to demonstrate any wide-scale project for general application, the combination of canegrowing with some form of stock-feeding is both logical and practical. The results of the small-scale trial at the Mackay Station demonstrate that lamb-raising can at least be effected under coastal conditions which would be regarded as far from ideal.

Work of the Stations.

The detailed statements of the work carried out at the three Experiment Stations appear in the ensuing pages of this Report.

WORK OF THE BRISBANE LABORATORY.

Mr. C. R. von Stieglitz, Chemist.

Routine Analyses.—The following is a summary of the routine analyses performed at the Brisbane Laboratory for the period 1st July, 1938, to 30th June, 1939:—

Soils	473
Waters	59
Basic lead acetates	24
Sugar canes	14
Limes	13
Green manures	12
By-products	11
Fertilizers	1
Total	607

As in previous years, numerous soil samples were submitted by farmers for fertilizer advice based on analytical figures. In order to furnish this information as quickly as possible, arrangements have been made to handle Northern samples at Meringa in future, wherever possible.

Laboratory Training for Field Officers.—Mr. N. Smith, Cadet, spent several months in the Brisbane Laboratory receiving instruction in the simpler analytical methods before taking up his field duties at Innisfail.

Division of Soils and Agriculture—continued.

Investigational Work.—Papers published as the result of investigational work were:—

Bureau "Technical Communications" Nos. 9 and 10.

No. 9—"The Laboratory Determination of Soil Fertility," and

No. 10—"Studies in Soil Sampling Technique," by H. W. Kerr and C. R. von Stieglitz; and

"Hints on the Manipulation of the Electrometric Method for Reducing Sugars," by C. R. von Stieglitz.

With reference to the first paper, the results embody investigational work which has been proceeding since 1935, when a paper on the same subject was presented at the Conference of the International Society of Sugar Cane Technologists held in Brisbane. The results obtained confirmed the 1935 findings for phosphate availability and provided the data necessary to place potash availability on a similarly sound basis, thus permitting fertilizer advice on analytical figures to be made with confidence. Both "Technical Communications" mentioned above were presented in an abridged form at the Louisiana Conference of the I.S.S.C.T., the latter paper forming part of a symposium on soil sampling methods.

The results published in this latter paper demonstrate the very important part that correct sampling technique plays in forming the correct estimate of soil fertility needs, based on analytical figures.

The paper "Hints on the Manipulation of the Electrometric Method for Reducing Sugars" was presented at the Ayr Conference of the Queensland Society of Sugar Cane Technologists, and amplified the findings of previous investigations of this method. A demonstration of the method was also given to members of the Society. This was made possible by the courtesy of the Kalamia Estates.

Further investigational work included a fertility survey in collaboration with Mr. Knust, Instructor in Cane Culture, of the soils in No. 6 Branch, South Johnstone. This survey will extend over four years until all the blocks have been sampled when carrying a mature plant crop.

The soils of this area are largely red volcanic and red schist, a few alluvial patches being found near the watercourses. The volcanics and schists intermingle freely, and the survey has proved valuable in fixing the boundaries of these two main types. This is very important from the fertility viewpoint as volcanics and schists normally require different fertilizer treatment. Coloured maps have been prepared showing variations in available phosphate, potash, and pH, thus providing the field officers with a convenient source of reference.

Detailed analytical work is being carried out on samples obtained from the Bundaberg and Mackay Experiment Stations, where rotational trials have been laid down as long distance experiments. The plan of these experiments will be found in the reports of the Officers in Charge of the respective Experiment Stations. The analytical work, which will be carried out yearly, is being undertaken with a view to following the trend of available plant nutrients and physical properties of the soils under the different systems of rotation. Results to hand show that the area selected at Bundaberg is fairly uniform in chemical constituents and after the fallow period is well supplied with the three main plant foods—nitrogen, phosphoric acid, and potash. The Mackay rotational cane and grazing blocks show a greater variation in chemical properties from block to block, are all low in available phosphate, and generally strongly acid.

Samples from the trash *versus* no trash plots at Bundaberg will also be examined periodically.

As further permanent trials are established at the different stations, samples will be taken for examination in the Brisbane Laboratory in order to keep a check on any chemical changes taking place as a result of the various treatments.

NORTHERN SUGAR EXPERIMENT STATION, MERINGA.

Mr. R. W. Mungomery, Acting Officer in Charge.

METEOROLOGICAL.

The weather conditions for the 1938-39 growing season were characterised by extreme variations, the first six-month period being relatively dry, whilst the second was abnormally wet and constituted one of the wettest periods on record for this Experiment Station.

July was ushered in with useful rains, and those farmers who were sufficiently enterprising to run the risk of commencing their late plantings during a period that is normally cold, were fortunate in experiencing light showery and warm weather, and excellent strikes were obtained. On the other hand, where planting was delayed until August and September the land had, by that time, dried out to a considerable extent and the cane was very slow in coming away. In many such cases indifferent strikes resulted. Light falls of rain were registered for these months but they were insufficient to promote vigorous growth and the moisture was soon lost in evaporation. Dry conditions, resulting in wilting and distress of the young crops, then continued until mid-October, when serviceable rains fell and the position was relieved. From then onwards the young crops began to make noticeable headway and further showery conditions during November, coupled with higher temperatures, gave a further impetus to growth. Except for a short period during December adequate soil moistures were maintained, and some of the crops had so advanced by then that interspace cultivation was no longer necessary.

During January the heavy monsoonal rains commenced, and these continued with minor breaks until May, when finer conditions prevailed. From February until May it was not possible to carry out any cultivation work, but this did not prove a serious disadvantage as most of the cane was out of hand early in the year and needed no further attention. The heavy rains caused much of the taller cane to lodge in March, and this lodging was accompanied, in many varieties, by a considerable amount of shooting of the upper eyes of the stalk. During May the rains eased considerably and it was then possible to get the land prepared for early planting, even though these early plantings had, of necessity, to be carried out later than usual. By that time many varieties had arrowed prolifically. Another heavy downpour in June, accompanied by considerable wind, flattened much of the cane that had withstood the March and April cyclonic weather, but it ensured a good strike in many of the early planted fields.

Altogether, it might be stated that the continued wet season rains caused much flooding, with resultant damage to cane, soil erosion, and water-logging of the soil on many of the low-lying areas. In these latter situations growth was somewhat retarded, but this retardation in growth was more than counterbalanced by the increased crops on the higher lands.

The following are the rainfall records taken at this Experiment Station since the year 1916:—

Year.	Rainfall in inches.	Year.	Rainfall in inches.
1916	100·73	1929	102·28
1917	66·81	1930	107·61
1918	69·15	1931	98·82
1919	57·53	1932	76·31
1920	94·86	1933	96·06
1921	122·84	1934	91·44
1922	64·90	1935	59·91
1923	53·29	1936	88·81
1924	95·67	1937	46·33
1925	76·98	1938	55·86
1926	59·12	1939 (6 months)	114·45
1927	90·16	**Average (23 years)**	**80·08**
1928	66·33		

Work of the Northern Sugar Experiment Station, Meringa—continued.

Abstract of Meteorological Observations made at the Northern Sugar Experiment Station, Meringa, from the 1st July, 1938, to 30th June, 1939.

Month	Rainfall in Inches.	Number of Wet Days.	Highest Shade Maximum.	Lowest Shade Maximum	Mean Shade Maximum.	Highest Shade Minimum.	Lowest Shade Minimum.	Mean Shade Minimum.	Mean Diurnal Range.	Mean Temperature, 9 a.m.	Mean Relative Humidity, 9 a.m.
July, 1938	2·26	9	88·8	62·7	78·4	64·3	46·0	57·2	21·3	68·8	83
August, 1938	0·89	13	90·2	74·0	81·0	68·5	44·7	58·7	22·6	71·7	81
September, 1938	0·71	12	90·2	78·2	84·1	62·8	54·0	58·9	25·8	75·3	70
October, 1938	2·72	17	92·2	80·7	87·6	72·3	59·0	64·7	22·8	81·4	66
November, 1938	2·98	13	94·2	82·6	90·0	75·0	65·5	69·0	21·1	81·8	75
December, 1938	2·38	11	97·8	83·7	90·7	76·9	63·0	70·7	19·8	82·4	76
January, 1939	26·15	19	100·4	83·8	90·0	75·2	66·3	72·6	17·4	81·6	82
February, 1939	36·85	14	95·3	78·6	87·7	74·0	65·2	71·7	16·0	79·7	85
March, 1939	34·68	19	97·0	76·6	88·5	74·9	62·8	70·6	17·5	80·2	83
April, 1939	9·28	22	88·2	78·0	84·3	73·5	62·5	69·7	14·9	77·6	85
May, 1939	2·68	12	86·4	78·0	82·8	68·0	57·0	62·9	19·9	74·2	86
June, 1939	4·81	7	85·5	75·0	80·9	68·1	51·5	61·5	19·9	71·3	82
Totals	126·39	168	..	..	..	..	..	..	..	..	..

1938 Crop.

Harvesting commenced on the 14th September and continued without interruption until 24th October, the tonnage sent to the mill amounting to 235 tons. In comparison with last year's harvest this represents a reduction in tonnage, and this in turn reflects the restriction in acreage due to the previous outbreak of downy mildew disease, when susceptible varieties had to be eliminated. Since the clean-up of this disease in 1937, it has been kept well controlled.

The following table gives a summary of crop data for the year:—

	Tons.
Cane sent to the mill	235
Cane used for plants	7
Total	242
	Tons.
Plant cane	187
Ratoon cane	55
Total	242
	Tons.
Badila	91
S.J. 4	107
Seedlings	44
Total	242
Area harvested	**8·96**
Average tons per acre	**27·0**

Land Clearing and New Plantings.

In order to consolidate within a more circumscribed area the blocks containing the third and fourth year selected seedlings, and have them in a workable rotation, a further 5 acres of land was acquired from a neighbouring property. This new land, although somewhat poor, is of a more even nature than any other land available on this Experiment Station, and hence more suited for varietal trials of this kind. Since portion of our cultivated land is similar to and adjoins this newly acquired land, it has been possible by means of a rearrangement of blocks to achieve this desirable end of having the more advanced seedlings under closer observation. This new land was fenced, and the year's programme involved the clearing of 2·8 acres, which was grubbed during the wet season, when clearing operations were greatly speeded up as a result of the wet condition of the land. The area has since been ploughed and prepared for planting during the coming spring. Elsewhere on this Experiment Station a further half acre was grubbed and planted to fodder canes, grasses, and legumes, and another strip of country involving approximately 1 acre was cleared and

Work of the Northern Sugar Experiment Station, Meringa—continued.

prepared for planting miscellaneous varieties, for use in the cross-pollination campaign. Thus, in all, an area of over 4 acres was cleared and brought under cultivation during the year. New plantings made during the year consisted of 1 acre of Badila, 2·9 acres Q. 10, and approximately 0·7 acre of miscellaneous varieties. These plantings exclude original and selected seedlings which are detailed elsewhere.

Seedling Work.

Of the third year seedlings, six varieties, comprising five of the "G" series and one of the "H" series, were ultimately selected and planted out in one-twentieth acre plots with S.J. 4 as a standard.

The remainder of the "H" series, comprising four selected seedlings, together with twenty-five selections from the "I" series and forty selections from the "J" series, were treated as second year seedlings and planted out in small plotlets of 4 rows each with 10 setts to a row, with S.J. 4 planted after every fifth plot as a standard. The standards in alternate series of plotlets were staggered with reference to each other, and in this way each plotlet of a seedling cane came adjacent either laterally, longitudinally, or diagonally, to a standard for comparison purposes. This arrangement represents a new departure from the previous plan of planting, and is an attempt to place seedling selection on a sounder basis.

Owing to the extremely dry weather conditions operating prior to and during the 1938 cross-pollination season, the number and variety of crosses that could be carried out was seriously reduced. Badila arrowed extremely poorly and late; consequently few crosses could be made with this desirable parent and this has resulted in a scarcity of seedling canes exhibiting the stocky type of growth which is so suited to North Queensland conditions.

In all, 8,728 original seedlings were planted out in the field during 1938, but since the majority of these are of the tall type, the available material from which promising "K" seedlings can be selected is somewhat limited. Further details in connection with the actual cross-pollination campaign are outlined elsewhere in this Report in the special section devoted to the Report of the Committee on Seedling Propagation.

Legumes.

During the winter months of 1938, a number of legumes including dun peas, blue field peas, New Zealand lupins and golden vetches, were tried as possible green manure crops for this period of the year, but of these the dun pea alone gave promise of being of any value in this respect. Weather conditions were showery during their period of growth, and the length of vine produced by the dun pea varied from 3 feet 6 inches to 4 feet 6 inches, which must be regarded as satisfactory. A further planting of dun peas was made in the early winter months of 1939, but the growth was patchy and not so vigorous as that of the preceding year. Apparently this pea thrives best under reasonably moist soil conditions.

In October and December, 1938, two trial plantings of summer legumes were made from selections of crossbred varieties of cowpeas received from the Department of Agriculture. Suitable standards such as Poona, Groit, Victor, black and giant cowpeas were included in the trial, and seed was saved from the most promising varieties. Most of the new varieties tested were of the quick-maturing type, but their early and quick growth gave considerable promise that they may prove valuable for this district. Two varieties from the C.B.W. × Poona cross appeared to be desirable types.

In order to test the value of Gambia pea (*Crotalaria goreensis*) in the normal cycle of crop rotation, a trial crop of this legume was planted in November, 1938, after ploughing out a crop of Badila ratoons This crop was somewhat slow in its early growth, and the land on which it was grown tended to become weedy, but after reaching a height of 18 inches to 24 inches its growth was particularly rapid and all weed growth was soon smothered out. In five months it produced a crop over 6 feet high, yielding more than 24 tons of green matter per acre. This crop was readily turned under and disintegrated fairly rapidly. It appears to have a definite value as a green manure crop in North Queensland, where a slow maturing legume is required to cover the land during the wet season, and thus prevent soil packing and erosion.

Trials with Fodder Grasses.

Of the fodder grasses under trial *Panicum coloratum* and *Panicum maximum* (fine stem) yielded good crops and came away well after cutting. Both of these are likely to prove valuable for fodder purposes.

Work of the Northern Sugar Experiment Station, Meringa—continued.

A further six grasses—namely, *Panicum maximum* (special strain), *Paspalum scrobiculatum, Brachiaria brizantha, Eragrostis superba, Urochloa pullulans,* and *Urochloa bulbodes,* were planted for trial purposes, but the growth of these grasses is not sufficiently advanced to warrant any conclusions being drawn regarding their probable value.

Improvements.

During the year ten additional reinforced concrete benches were erected to accommodate potted seedlings. This has increased the bench space by 50 per cent. and lessened the possibility of congesting the seedlings in the flats in the glasshouse. The resulting acceleration of potting out will enable field plantings to be made more about the same period, and diminish the period between the first and last plantings.

A new small implement shed was built, and this will provide shelter for the excess implements that could not be housed in the larger shed. Provision has also been made in this building for a workshop.

The pipes for the water supply were renewed owing to serious corrosion and breakages, and the roadways which had become almost untrafficable during the continued wet weather were gravelled and sanded.

Laboratory Work.

The routine work of sampling new varieties was carried out at this Station, and the following samples were analysed during the year:—

Experiment Station analyses and maturity tests of new varieties	203
Farm trial analyses	52
Farmers' canes	3
Total	258

Field Day.

Following on the re-introduction of annual field days on the Bundaberg and Mackay Experiment Stations last year, the first annual field day on the Meringa Sugar Experiment Station was held on 7th June, 1939. The date for this function was so arranged that it coincided with a meeting of the Advisory Board on this Station, and thus members of the Board were enabled to be present. There was only a moderate attendance of growers, who were welcomed by the Director and the Deputy Chairman of the Advisory Board (Mr. N. H. Wellard), and later were addressed by members of the staff on various subjects relating to sugarcane agriculture. Keen interest was displayed in an exhibit showing the technique of crossing, and in young seedling canes in various stages of development growing in the glasshouse, and after viewing these, an inspection was made of the older seedlings and miscellaneous canes growing in the field.

CENTRAL SUGAR EXPERIMENT STATION, MACKAY.

Mr. D. L. McBryde, Chemist in Charge.

METEOROLOGICAL.

Although the total rainfall for the period was normal (59·29 inches) the monthly distribution varied very considerably from the average, resulting in an abnormal condition of crops at the commencement of the 1939 harvest.

Rainfalls in August and September, 1938, and again in December, were very short of requirements, and the December shortage was considerably aggravated by the lateness of good rain in January, 1939. In fact, at the end of January, a serious state of drought occurred, being most severe in the Proserpine area, and the outlook for the coming harvest was not bright.

However, from the end of January until June, the sequence of rainfalls, all of a quiet, soaking nature, altered the prospects, and it was seen that yields would again compare favourably with those of the previous crop. A feature of the crop which resulted from the favourable growing conditions of April and May is its extreme immaturity for the commencement of harvesting.

For the third season in succession there was an absence of water-logging of the soil, and, as a consequence, it may be expected that the sound condition of crops will permit of ripening to a high standard of sweetness in due course, while there should be little evidence of drought damage during the spring months, no matter how dry the season may remain.

Abstract of Meteorological Observations made at the Sugar Experiment Station at Mackay, from 1st July, 1938, to 30th June, 1939.

Month.	Inches Rain.	Wet Days.	Average Rainfall.	Shade Temperatures :—					
				Maximum.			Minimum.		
				High.	Low.	Mean.	High.	Low.	Mean.
1938.									
July	2·43	7	1·46 (*a*)	81·5	50·5	71·2	65·0	38·5	49·8
August	0·24	6	0·91 (*a*)	83·0	67·5	78·0	58·5	37·5	48·9
September	0·18	3	1·70 (*a*)	91·0	74·0	79·1	62·5	42·5	57·0
October	2·06	2	1·72 (*a*)	86·5	79·0	82·4	71·0	54·0	62·1
November	5·30	15	3·11 (*a*)	91·0	79·0	84·4	74·0	63·5	68·2
December	1·91	3	7·37 (*a*)	93·5	82·0	87·5	75·5	61·0	68·3
1939.									
January	5·07	12	13·90 (*b*)	95·0	83·5	88·7	75·0	66·0	70·9
February	14·45	22	11·26 (*b*)	87·0	77·5	82·7	75·5	64·5	70·2
March	10·34	19	10·56 (*b*)	95·0	81·5	85·5	73·0	64·5	68·5
April	9·37	23	5·07 (*b*)	82·5	72·5	79·7	70·0	49·5	64·7
May	7·11	12	3·38 (*b*)	79·5	68·5	77·0	62·0	45·5	57·9
June	2·83	10	2·62 (*b*)	83·0	66·0	73·1	64·5	40·5	52·7
Totals	59·29	134	63·03	..	..	..	..	..	..

(N.B.—Average Rainfalls—(*a*) = 38 and (*b*) = 39 years.

An outstanding feature of the above table is the "low" maximum reading during July. This reading (50·5 degrees) is 6·8 degrees lower than the previous record for the past thirty-nine years.

Annual Rainfalls since 1920 at the Sugar Experiment Station, Mackay.

Year.	Rainfall in Inches.	Year.	Rainfall in Inches.
1920	57·27	1930	55·81
1921	95·89	1931	30·01
1922	34·47	1932	48·48
1923	25·23	1933	71·94
1924	53·37	1934	37·57
1925	54·80	1935	45·15
1926	34·69	1936	97·37
1927	83·87	1937	56·60
1928	72·28	1938	52·18
1929	64·03	1939 (6 months)	49·17
		Average (19 years)	**56·37**

Work of the Central Sugar Experiment Station, Mackay—continued.

Experiments Harvested during 1938.

1. Varietal Trial.—Mackay Seedlings *v.* Q. 813, Latin square, 2nd ratoon.
2. Observational Varietal Trial.—Mackay Seedlings *v.* Q. 813. Plant crop.

Experiments Initiated during 1938.

1. Varietal Trial.—Mackay Seedlings, Comus, and Q. 813. Latin square 5 × 5.
2. Observational Varietal Trial.—Mackay Seedlings *v.* Q. 813.
3. Downy Mildew Resistance Trial.—Mackay Seedlings *v.* Standards.

VARIETAL TRIAL (Second Ratoon Crop).

Plan and Yields.

C 83 25.9	Q 813 12.9	Q 20 18.5	C 85 20.1
C 85 25.1	Q 20 18.5	C 83 24.6	Q 813 10.5
Q 20 17.9	C 85 26.5	Q 813 14.5	C 83 23.1
Q 813 19.0	C 83 26.2	C 85 28.2	Q 20 22.3

(*Note*: Q. 20 was formerly known as C. 57.)

Block.—B2.

Harvested.—Mid-September for all varieties except Q 20, which was cut for plants in July.

Age of Crop.—12 months (Q. 20 plots, 10 months).

Experimental Plan.—4 × 4 Latin square.

Plots.—0·102 acre.

Fertilizer applied.—All plots were uniformly fertilized at ratooning time (October) with Sugar Bureau No. 1 ratooning mixture, 4 cwt. per acre.

Early in November, 1938, and January, 1939, top dressings of sulphate of ammonia were applied each of 2 cwt. per acre.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ Log$_e$ (Mean Square).
Rows	3	52·83	17·61	..
Columns	3	20·31	6·77	..
Treatments	3	320·48	106·83	2·3355
Errors	6	20·12	3·35	0·6045
Total	15	413·74	..	..

Crop Yields—Second Ratoons.

—	Q. 813.	Q. 20.	C. 83.	C. 85.
Cane, tons per acre	**14.2**	**19.3**	**25.0**	**25.0**
Cane, percentage mean yield	68·1	92·5	119·7	119·7
C.C.S. in cane, per cent.	**16.3**	**17.5**	**15.9**	**17.1**

Standard Error = 4·38 per cent.

Summary of Yields—Plant, First, and Second Ratoons.

Variety.	Plant Cane.		First Ratoons.		Second Ratoons.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
Q. 813	**32.0**	**16.6**	**30.4**	**16.6**	**14.2**	**16.3**
Q. 20	**30.6**	**17.6**	**34.3**	**18.4**	**19.3**	**17.5**
C. 83	**40.0**	**16.4**	**42.7**	**16.5**	**25.0**	**15.9**
C. 85	**32.8**	**16.8**	**37.9**	**16.4**	**25.0**	**17.1**

Work of the Central Sugar Experiment Station, Mackay—continued.

DISCUSSION.

This marks the completion of the first varietal trial conducted on the Mackay Station with seedlings raised at that centre.

C. 83 has proven an exceptional yielder, while C. 85 has also exhibited noteworthy ratooning qualities. Unfortunately, both are so susceptible to downy mildew disease that they cannot be released for commercial plantings in the Mackay area at present.

Q. 20 (serial number C. 57) has maintained its promise, though inferior in yield to the above mentioned seedlings; but it exhibits an exceptionally good sugar content, and possesses a high measure of disease resistance. The variety has now been distributed for experimental plantings on a wide scale this year.

OBSERVATIONAL VARIETAL TRIAL (Plant Crop).

Block.—C2.

Experimental Plan.—Randomised duplicate plots.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.
E. 4	43·5	15·1
E. 45	39·0	13·3
E. 20	32·5	11·6
E. 30	29·0	11·8
E. 54	23·5	13·4
E. 91	22·5	9·9
Q. 813	33·7	13·4

DISCUSSION.

This preliminary trial with selected seedlings was made with the object of assisting in a final selection for Latin square trial purposes. Two of the varieties (E. 4 and E. 45) showed promise in that both outyielded the standard (Q. 813), and showed a satisfactory C.C.S. content. They were planted in a full scale trial during 1938, and were also placed in disease-resistance trials. Both are seedlings of P.O.J. varieties.

The plots of the observational trial were ratooned, and will be harvested again during 1939.

ROTATIONAL EXPERIMENTAL BLOCK.

Block.—C.

Experimental Plan.—Area divided into eight plots, each approximately 2 acres. One plot taken into cultivation each year; plant and first ratoon crops harvested, plot green manured, seeded to grass, and taken back into grazing area. Approximately 40 sheep are run on the plots not in cultivation.

Crop Yields.

Plot.	Variety.	Harvested.	Nature of Crop.	Cane per Acre.	C.C.S. in Cane.
				Tons.	Per Cent.
C. 1	C. 83	1937	Plant	**26·2**	15·7
		1938	1st Ratoon	**29·8**	16·8
C. 2	Mixed	1938	Plant	**31·8**	15·3

Work of the Central Sugar Experiment Station, Mackay—continued.

DISCUSSION.

Plots C1 (ratoons) and C2 (plant cane) were harvested during 1938, and all trash and tops were conserved. On plot C1, the stools were ploughed out a few weeks after harvesting, and sown to Poona pea When this had been turned under and rotted, Rhodes grass was sown, and the area eventually added to the balance of the grazing area. It will remain thus until 1943, when a further green manure crop will be grown and ploughed under before planting to cane.

Plot C2 had the trash rolled in every third interspace, and the balance of the plot was ratooned in the standard manner. The plot was fertilized with Sugar Bureau No. 1 ratooning mixture (4-13-6) at the rate of 4 cwt. per acre, and later top dressed with sulphate of ammonia. The ratoon crop has made very good progress and should yield almost as heavily as the plant cane.

Plot C3 was carefully attended to in respect of surface drainage before being planted to cane in May, 1938. The variety used was Q. 20. Some damage from wireworms was experienced, while cool conditions also delay germination. However, good progress was made later, and it is expected to yield 35 tons of cane per acre.

Plot C4 has been carefully cultivated and graded, and it will be planted in the spring of 1939.

Sheep-grazing.

The sheep running on the grazed blocks of Division C have done fairly well during the year, although there was a scarcity of natural feed during the spring, and supplementary feeding was necessary. The animals were given, during this period, a daily ration of—

1 lb. chop chop (cane tops or grass),
1 lb. molasses,
1 oz peanut or cotton seed meal.

Although this light ration was not sufficient to maintain the sheep in prime condition when grass was very scarce, it kept them from falling-off to a serious degree, and enabled the ewes to produce their lambs without undue loss.

Worm infestation was more serious than in previous years, and the animals had to be drenched several times. Once again there was no evidence of foot rot, and only two ewes were struck by blow-fly during the year. Two old ewes died from pneumonia.

The flock varied from 37 to 51 sheep during the year. Unfortunately, the major grass species (*Panicum muticum*) is going back with prolonged grazing, but there has been an increase in the proportion of sensitive plant (*Mimosa pudica*) in the pasture.

The sheep were shorn during October, with an average yield of 5 lb. of wool per head.

The plan to be followed is to eliminate the old ewes as young stock attain breeding age. The latter will be crossbreds (Merino x Romney Marsh), and it is anticipated that a very satisfactory type of lamb will result when these are again mated with a Romney Marsh sire.

Drainage Improvements.

During the preparation of fallow blocks for replanting, attention has been given to the matter of improved surface drainage. Blocks A.1, B.3, and C.4 were each scooped, to remove ridges and fill depressions. These now present a gradual fall from end to end.

Irrigation Plant.

The former system of irrigation for young seedlings has been replaced by a spray system.

Glasshouse.

A seedling glasshouse was constructed during the year. It adds to the convenience with which this work may now be conducted, and the heating system enables a good control to be maintained on temperatures during cold nights.

Seedling Equipment.

A further three concrete seedling benches were completed, giving 21 in all. Germination benches fitted with castors were constructed for use in the glasshouse, and additional flats prepared. These additions will enable the full annual quota of seedlings to be raised without the necessity for working in batches, and the seedlings should therefore reach the field much earlier than in previous years.

Work of the Central Sugar Experiment Station, Mackay—continued.

Station Horses.

The Station horses have been kept in satisfactory condition throughout the year. Occasional veterinary attention was given as required. The horses have been maintained throughout on the standard ration consisting of—

18-20 lb. chop chop (cane tops or grass),
2 lb. molasses,
12 oz. peanut or cotton seed meal.

When the animals are in work they are given three feeds daily; two feeds are allowed on Saturdays, and one on Sundays, or when the horses are not being worked.

The heavy molasses is lightly diluted with water just prior to use, and poured over the dry constituents of the feed in the feed-boxes.

Laboratory Work.

The following is a record of the cane analyses performed at the Station during the year:—

Station samples	86
Farmers' samples	181
Mackay Show exhibits	42
Farm trial samples	10
	319

Summary of Crop Yields, Season 1938.

Block.	Variety.	Class of Cane.	Tonnage Harvested.	Tons Cane per Acre.
A 1	Seedlings	Plant	53·0	26·5
B 2	Varieties	Second Ratoon	34·6	18·2
B 3	P.O.J. 2725 and Q. 813 ..	First and Second Ratoons	170·2	18·7
C 1	C. 83	First Ratoon	62·5	29·8
C 2	Seedlings	Plant	57·4	31·8
D 2	M. 1900 and Q. 20	Plant	118·0	15·9
		Total and average	495·7	20·4

Area harvested = 24.3 acres.

SOUTHERN SUGAR EXPERIMENT STATION, BUNDABERG.

Mr. N. J. King, Chemist in Charge.

METEOROLOGICAL.

Good winter rains in 1938 gave a fair start to ratoons of early cut cane, and also to early spring plant crops. The incidence of a very dry spring, however, changed the promise of the season, and this was followed by an abnormally dry summer. December rains were less than a quarter of an inch, and no rain fell in January until the third week of the month. February also yielded well below average precipitation, but March and April rains brought about good growth; May was another dry month. Crops consequently are behind those for the previous year.

Crops.

The 1938 crops in the Bundaberg district were of record proportions, and it is largely owing to the amount of cane stood over in that year that good estimates are again possible for the forthcoming 1939 crushing season. In the Report for 1938 the value of standover crops was emphasised, and that value will be appreciated by growers in the present year. Without the large amount of cane from last season the district would obviously not be in an unfavourable position; the total rainfall from July, 1938, to June, 1939, and its poor distribution would have produced only average crops for the coming harvest. As in previous years, a considerable amount of the standover P.O.J. 2878 is already over-mature as evidenced by the higher purity in the top half of the stalk. This occurs in most years in Bundaberg owing to dry autumns and very early sugar production in the standover crops. In this district where a large proportion of the variety is grown as a two-year crop, it would probably pay to advance rather than delay the commencement of crushing.

Rainfall Records.

The following are the rainfall records taken at this Station since the Experiment Station began operations in 1914. To conform with the year covered by the Report the rainfalls are given for the year beginning in July and ending in June:—

1914-1915	31·99	1927-1928	74·69
1915-1916	28·54	1928-1929	31·16
1916-1917	58·08	1929-1930	43·16
1917-1918	49·85	1930-1931	47·19
1918-1919	24·24	1931-1932	22·88
1919-1920	28·20	1932-1933	36·81
1920-1921	45·16	1933-1934	71·45
1921-1922	44·97	1934-1935	40·01
1922-1923	37·14	1935-1936	44·24
1923-1924	34·16	1936-1937	31·65
1924-1925	50·96	1937-1938	44·40
1925-1926	37·62	1938-1939	41·01
1926-1927	68·18		

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Abstract of Meteorological Observations made at Southern Sugar Experiment Station, Bundaberg, from 1st July, 1938, to 30th June, 1939.

Month.	Rainfall.	No. of Wet Days.	Highest Shade Max.	Lowest Shade Max.	Mean Shade Max.	Highest Shade Min.	Lowest Shade Min.	Mean Shade Min.	Mean Diurnal Range.	Mean Temp. 8 a.m.	Mean rel. Humidity 8 a.m.
1938.											
July	4·00	12	75	51	68	58	38	49	19	55·5	87
August	1·49	4	79	64	71	53	37	45	26	56	87
September	0·22	3	86	72	77	58	41	51	26	68	69
October	2·91	9	86	74	81	67	54	60	21	76	64
November	4·63	14	90	76	83	72	60	66	17	78	78
December	0·23	3	95	82	87	75	58	67	20	81	63
1939.											
January	9·75	9	94	82	87	78	63	70	17	79	82
February	2·43	7	91	81	84	75	63	67	17	77	77
March	8·08	19	91	75	83	75	59	67	16	75	81
April	3·07	11	83	65	78	67	49	60	18	68	84
May	0·71	9	81	71	76	64	44	55	21	63	83
June	3·49	7	75	64	70	61	36	47	23	57	87
Totals	41·01	107	..	..	..	..	..	..	..	..	..

New Experiments Initiated during the Year.

(1) Observational Yield Trial—

Nine advanced seedlings of F series against Co. 290.

(2) Varietal Trial—

5 × 5 Latin square, 3 seedlings and Comus against Co. 290.

(3) 40-Stool Plot Trial—

Forty-five new seedlings from Co. 290 × P.O.J. 2878 cross against Co. 290.

(4) Type of Nitrogen Trial—

5 × 5 Latin square with ammonium sulphate *v.* cyanamide *v.* dried blood *v.* sodium nitrate.

(5) Molasses Trial—

Eight tons molasses per acre *v.* ½ molasses plus half fertilizer equivalent *v.* fertilizer equivalent of molasses *v.* no treatment.

(6) Rotational Trial—

The second section of this trial was planted in February, 1939.

Experiments Harvested during 1938.

(1) Varietal Trials—

(*a*) Gumming resistant varieties, second ratoon crop.

(*b*) Gumming resistant varieties, first ratoon crop.

(*c*) P.O.J. 2878 *v.* Co. 290, single *v.* double planting, second ratoon crop.

(*d*) New seedling canes *v.* Co. 290 and P.O.J. 213, first ratoon crop.

(*e*) Randomised block, Co. 290 *v.* P.O.J. 213, plant crop.

(*f*) New seedling canes *v.* Jason, Comus, Co. 419 and Co. 290, plant crop.

(*g*) Seedlings Q. 22, 23, 24 and 25 *v.* Co. 290, plant crop.

(2) Cultivation Trials—

(*a*) Trash conservation trial, P.O.J. 2725, first ratoon crop.

(3) Fertilizer Trials—

(*a*) Nitrogen and phosphate trial, second ratoon crop.

(*b*) Potash trial, first ratoon crop.

(*c*) Nitrogen trial, time of application, P.O.J. 2878 *v.* P.O.J. 2725, second ratoon crop.

(*d*) Factorial trial, Co. 290, three levels of N, P and K, plant crop.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

VARIETAL AND INTERSPACING TRIAL (Second Ratoon).

Plan and Yields.

Inter-space.		
4′	Co 290 26.9	POJ 2878 21.2
5′	POJ 234 21.6	POJ 2725 34.1
I.		IV.
5′	POJ 2878 21.2	Co 290 27.8
4′	POJ 2725 28.7	POJ 234 24.0
4′	Co 290 22.1	POJ 2725 34.4
5′	POJ 2878 20.3	POJ 234 25.3
II.		V.
4′	POJ 234 22.0	POJ 2878 23.8
5′	POJ 2725 34.3	Co 290 27.1
5′	POJ 2878 21.7	POJ 2725 33.2
4′	Co 290 29.7	POJ 234 23.1
III.		VI.
5′	POJ 234 19.9	Co 290 26.9
4′	POJ 2725 34.6	POJ 2878 21.6

Block.—B6.

Harvested.—September, 1938.

Age of Crop.—11 months.

System of Replication.—6 randomised blocks.

Varieties.—P.O.J. 234, 2725, 2878, and Co. 290.

Interspaces.—5 feet *v.* 4 feet.

Plots.—0·091 acre.

CULTIVATION.

After harvesting the first ratoon crop in 1937, all plots were ratooned with the single-tyne subsoiler, three times per interspace. All plots were fertilized uniformly with Sugar Bureau No. 3 ratooning mixture (4·5 – 6·5 – 22·5) at the rate of 4 cwt. per acre. During November, sulphate of ammonia was applied as a top dressing at the rate of 1½ bags per acre.

GROWTH NOTES.

Growth progressed unchecked until February, when a dry spell of very hot weather caused distress to all varieties. Good autumn growth conditions followed, and the ratoons yielded very satisfactorily.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ $\log_e$ (Mean Square).
Blocks	5	29·13	5·83	..
Varieties	3	497·51	165·84	2·5555
Interspace	1	0·07	0·07	..
Errors	14	53·05	3·79	0·6662
Totals	23	579·76	..	..

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Crop Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
	Tons.	Per Cent.	Tons.
P.O.J. 2725	33·2	13·8	4·58
Co. 290	26·8	13·2	3·54
P.O.J. 234	22·7	14·1	3·20
P.O.J. 2878	21·6	13·3	2·87

Standard Error = ± 0·78 tons cane.

Summary of Crop Yields—Plant, First and Second Ratoon Crops.

Variety.	Plant Cane.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
P.O.J. 2725	31·4	14·9	19·8	17·4	33·2	13·8
Co. 290	28·4	14·1	14·6	15·5	26·8	13·2
P.O.J. 234	23·9	15·2	13·5	16·1	22·7	14·1
P.O.J. 2878	16·9	13·9	7·8	15·2	21·6	13·3

DISCUSSION.

This trial has now been concluded. Variety P.O.J. 2725 has demonstrated its marked superiority throughout, though it is doubtful whether this would hold over a series of trials on this soil type. The standard cane, P.O.J. 2878, suffered from dry conditions in both plant and first ratoon crops, and actually gave the lowest yield of all varieties for all crops.

P.O.J. 2725 is undoubtedly a very valuable variety under Southern Queensland conditions as a one-year-old cropper; it possesses the drawback that it is free-arrowing, and therefore is unreliable for standover purposes.

For all crops, the variation in interspace distance has produced a negligible influence on crop yield.

VARIETAL TRIAL (First Ratoon Crop).

Plan and Yields.

POJ 2878 33.7	Co 290 32.0	POJ 234 23.0	POJ 2940 35.4	POJ 2883 36.0
POJ 2875 37.7	POJ 2883 33.4	POJ 2875 35.4	POJ 2878 33.0	POJ 234 25.1
POJ 2725 31.7	POJ 2940 36.6	POJ 2883 35.4	Co 290 34.0	POJ 2878 35.4
POJ 234 23.3	POJ 2875 38.0	Co 290 34.3	POJ 2725 32.6	POJ 2875 36.9
POJ 2883 37.4	POJ 2725 33.3	POJ 2940 35.7	POJ 234 26.8	Co 290 33.7
POJ 2940 38.9	POJ 234 26.5	POJ 2878 32.0	POJ 2875 38.9	POJ 2725 31.7
Co 290 36.9	POJ 2878 33.3	POJ 2725 33.7	POJ 2883 35.1	POJ 2940 38.0

Harvested.—October, 1938.

Age of Cane.—13 months.

System of Replication.—5 randomised blocks.

Plots.—0·0434 acre.

TREATMENT.

After harvesting the plant crop in 1937 all plots were ratooned by the use of the subsoiler three times in each interspace. Fertilizer was applied uniformly to all plots at the rate of 4 cwt. of Sugar Bureau No. 3 ratooning mixture (4·5-6·5-22·5) per acre, followed by 1½ bags sulphate of ammonia per acre in late November, 1937.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

GROWTH NOTES.

The plots ratooned well, but suffered a severe set-back with the hot, dry conditions of February, 1938. Growth thereafter continued throughout the winter of 1938, due to the favourable conditions which prevailed, and heavy tonnages resulted.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ $\log_e$ (Mean Square).
Blocks	4	8·41	2·10	..
Varieties	6	525·54	87·59	2·2362
Errors	24	50·28	2·09	0·3685
Total	34	584·23	..	..

Standard Error = $\pm$ 0·65 tons cane.

Summary of Crop Yields—Plant and First Ratoon Crops.

Variety.	Plant Crop.		First Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.
P.O.J. 2875	22·1	15·6	37·4	14·9
P.O.J. 2940	20·0	16·8	36·9	16·0
P.O.J. 2883	21·6	16·3	35·5	15·1
Co. 290	15·0	16·3	34·2	14·7
P.O.J. 2878	20·0	15·3	33·5	14·7
P.O.J. 2725	18·8	17·6	32·6	15·7
P.O.J. 234	16·1	16·2	24·9	15·3

DISCUSSION.

The results from this trial to date are most interesting. They demonstrate that the variety Co. 290, which yielded poorly in the dry 1937 season, was able to make an extraordinary recovery in a good growing season. Further, it is seen that P.O.J. 2875, 2940, and 2883 were able to maintain the superiority which they exhibited for the plant crop; P.O.J. 2940 gave the highest C.C.S. in each season, followed by P.O.J. 2725 and 2883. P.O.J. 2878 did not show up to advantage in this trial, which involves the harvesting of all canes at one year old. It is the superiority of the variety as a standover cane which renders it so valuable in Southern Queensland: second in line in this regard is probably P.O.J. 2883, but this cane has not been released for planting, due to the prevalence of Fiji and downy mildew diseases. It may be used to replace 2878 later, should the position deteriorate.

VARIETAL TRIAL—SINGLE v. DOUBLE PLANTING (Second Ratoon Crop).

Plan and Yields.

POJ 2878 Single 20.7	Co 290 Double 27.6	POJ 2878 Single 22.9	Co 290 Double 26.5	Co 290 Single 25.8
POJ 2878 Double 27.9	Co 290 Single 25.6	POJ 2878 Double 27.6	Co 290 Single 24.5	Co 290 Double 27.0
Co 290 Double 26.5	POJ 2878 Single 23.4	Co 290 Double 27.7	POJ 2878 Single 20.4	POJ 2878 Double 20.5
Co 290 Single 27.9	POJ 2878 Double 25.0	Co 290 Single 27.7	POJ 2878 Double 26.7	POJ 2878 Single 20.7

Block.—A2.
Varieties.—P.O.J. 2878 *v.* Co. 290.
Harvested.—August, 1938.
Age of Crop.—10 months.
System of Replication.—5 randomised blocks.
Plots.—0·0694 acre.
Rows per plot.—8.

TREATMENT.

Planting—

Single.—Three-eye plants dropped singly with 6 inches between ends of setts.

Double.—Two setts (as for single) dropped side by side.

The first ratoon crop was burnt prior to harvest, and all interspaces were cultivated as usual by the use of the subsoiler. Fertilizer was applied to all plots at the rate of 4 cwt. of Sugar Bureau No. 3 ratooning mixture (4·5 – 6·5 – 22·5) per acre. All plots were subsequently top-dressed with sulphate of ammonia at the rate of 1½ bags per acre.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

GROWTH NOTES.

The growth of the ratoons was good from the start: late spring and early summer rains were above normal, but a serious check was experienced in February when very hot, dry weather prevailed. After recovering from this setback, no serious stoppage in growth occurred.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ Log$_e$ (Mean Square).
Blocks	4	21·16	5·29	..
Single *v.* double	1	27·38	27·38	1·6531
Varieties	1	48·05	48·05	1·9361
Errors	13	45·99	3·54	0·6321
Total	19	142·58	..	..

Standard Error = ± 0·60 tons cane.

Summary of Crop Yields—Plant, First and Second Ratoons.

(1). Varieties.

Variety.	Plant Crop.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
Co. 290	**33·0**	**15·2**	**14·9**	**14·8**	**26·7**	**10·5**
P.O.J. 2878	**25·3**	**15·7**	**14·3**	**15·4**	**23·6**	**11·6**

(2). Single *v.* Double Planting.

Variety.	Plant Crop.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
Single	**28·0**	**15·5**	**13·9**	**15·1**	**24·0**	**11·2**
Double	**30·3**	**15·4**	**15·3**	**15·2**	**26·3**	**10·9**

DISCUSSION.

The results of this trial are very interesting. Firstly, they demonstrate the vigorous growing qualities of Co. 290, given a favourable season, but show that the variety is susceptible to bad drought conditions, as was the case with the first ratoon crop. Moreover, P.O.J. 2878 was each year superior to the Indian cane in sugar content, and experience shows that Co. 290 is not a satisfactory standover variety. The low C.C.S. from the second ratoon crop is in consequence of the necessity for harvesting the crop while it was still far from mature.

Secondly, the value of "double-planting" is demonstrated very clearly by the yields of all three crops. Expressed percentagely the gains have been 8, 10, and 10, respectively. The sustained benefits have definitely outweighed the extra planting material used initially. Whether such a performance would be repeated in all trials cannot be stated with certainty, but it is a practice strongly to be recommended where the planting material may be faulty, or planting conditions unfavourable. The gains were definitely due to the establishment of a better stool, where two plants were dropped. The effect of double planting on C.C.S. appears to have been slightly adverse, but the net effect is negligible.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

OBSERVATIONAL VARIETAL TRIAL (First Ratoon Crop).

Plan and Yields.*

A 2 37.2	A 1 33.9	Co 290 32.3	C 4 30.6
Co 290 32.7	C 9 36.0	POJ 213 35.1	Co 290 33.9
C 1 31.9	Co 290 34.7	Q 2 37.2	A 3 48.4
Co 290 34.1	C 11 35.5	C 8 35.5	Co 290 31.5
C 6 47.8	POJ 213 36.8	Co 290 34.7	C 12 43.7

* *Note.*—Guard rows were left for each plot, and yields were computed on the cane weight from the inner 6 rows.

Block.—Div. F.

Harvested.—November, 1938.

Age of Crop.—13 months.

Plots.—0·0306 acre.

TREATMENT.

After the plant crop was harvested in October, 1937, the trial was ratooned, as usual. All plots were uniformly fertilized with Sugar Bureau No. 3 ratooning mixture (4·5 – 6·5 – 22·5) at the rate of 4 cwt. per acre, and top dressed in December with sulphate of ammonia at the rate of 1½ bags per acre.

GROWTH NOTES.

All plots ratooned well, except that of C. 12, which was slow for the first two months but ultimately made good progress. Except for the growth check in February, vigorous growth was maintained throughout, and heavy yields resulted.

Summary of Crop Yields—Plant and First Ratoon Crops.

Variety.	No. of Plots.	Plant Crop.		First Ratoon Crop.	
		Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S in Cane.
		Tons.	Per Cent.	Tons.	Per Cent.
Co. 290	7	16·0	14·1	33·4	13·8
P.O.J. 213	2	23·4	13·8	36·0	14·4
A. 1	1	18·0	13·4	33·9	12·9
A. 2	1	17·9	15·4	37·2	15·3
A. 3 (Q. 22)	1	19·7	14·7	48·4	15·0
C. 1 (Q. 23)	1	15·9	14·4	31·9	15·3
C. 4 (Q. 24)	1	17·9	13·4	30·6	15·3
C. 6 (Q. 25)	1	26·0	14·8	47·8	16·5
C. 8	1	20·1	16·6	35·5	15·7
C. 9	1	14·8	11·8	36·0	13·2
C. 11	1	18·7	13·9	35·5	13·7
C. 12	1	26·8	14·5	43·7	12·3
Q. 2	1	20·8	16·3	37·2	15·6

DISCUSSION.

Prior to the harvest of the plant crop, varieties A. 3, C. 1, C. 4 and C. 6 were selected for further trial, and received the permanent numbers Q. 22, 23, 24, and 25, respectively. When actual yields were available, the performance of C. 12 was such as to warrant its being used for further trials, and it was planted out accordingly in 1938.

The yields of the ratoon crop indicate a clear superiority of certain of the new seedlings over the standard varieties Co. 290 and P.O.J. 213. This applies in respect of both yielding capacity and sugar content.

Of course, it will be borne in mind that the results from single plots cannot be regarded as more than indicative; for the subsequent performance of Q. 22, 23, 24, and 25, see p. 32 of this Report.

It might be noted that variety Q. 2, which has attained some popularity in North Queensland, was included in the trial. It gave a satisfactory result in both plant and ratoon crop, but its high susceptibility to gumming disease in these parts prohibits its propagation on a commercial scale.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

VARIETAL TRIAL—Co. 290 v. P.O.J. 213 (Plant Crop).

POJ 213 34.3	Co 290 35.1	POJ 213 32.7
Co 290 33.6	POJ 213 33.0	Co 290 34.3
Co 290 36.9	POJ 213 34.5	POJ 213 32.3
POJ 213 34.2	Co 290 35.7	Co 290 36.5
Co 290 34.2	POJ 213 32.5	Co 290 33.6
POJ 213 32.0	Co 290 34.0	POJ 213 31.3

Block.—B2.

Harvested.—August, 1938.

Age of Crop.—18 months.

Plots.—0·099 acre.

Experimental Plan.—Nine randomised blocks.

TREATMENT.

A fair Poona pea crop was ploughed under in January, 1937, and cane planted in February. All plots were fertilized uniformly with Sugar Bureau No. 3 planting mixture (2–8–25) at the rate of 4 cwt. per acre. No sulphate of ammonia was applied to the crop.

GROWTH NOTES.

Growth conditions were poor during most of 1937, but from November onwards good rains fell; the only subsequent check was due to the dry spell of February, 1938.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	8	15·52	1·94	..
Varieties	1	16·24	16·24	2·5450
Errors	8	6·92	0·87	1·0817
Total	17	38·68	..	..

Crop Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
	Tons.	Per Cent.	Tons.
Co. 290	**34·9**	**12·5**	4·36
P.O.J. 213	**33·0**	**13·4**	4·42

Standard Error = ± 0·31 tons cane.

DISCUSSION.

The object of the experiment was to determine the relative value of these varieties on the red volcanic lands. Certain growers still favour P.O.J. 213, and the results of the trial reported above substantiate their claims to a degree. The Indian variety out-yielded P.O.J. 213, in terms of cane, but the latter was almost one unit higher in C.C.S. when the crop was harvested.

It is interesting to note that Co. 290 showed a low C.C.S. in August, although it was 18 months old at that time.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

OBSERVATIONAL VARIETAL TRIAL (Plant Crop).

Plan and Yields.

E 14 44.5	Co 290 44.3	E 12 47.1	E 15 52.8
Co 419 *	E 16 35.5	E 18 36.2	Co 290 45.3
Co 290 41.9	E 10 34.4	E 6 36.0	Comus 37.8
Jason 31.3	E 3 29.2	Co 290 35.5	E 1 27.2

* Stoodover.

Varieties.—Seedling canes *v.* Co. 290.

Block.—D1.

Harvested.—October, 1938.

Age of Crop.—13 months.

Plots.—0·0483 acre.

TREATMENT.

The block was planted in the spring of 1937, after a winter fallow, which followed a summer green manure crop. The soil was in excellent condition when planted, as it followed a fall of rain. All plots were fertilized in the drill with Sugar Bureau No. 3 planting mixture (2–8–25) at the rate of 4 cwt. per acre.

GROWTH NOTES.

This block is not entirely satisfactory for experimental purposes, as a distinct soil moisture gradient exists from one end to the other. This is shown by the individual plot yields for the standard (Co. 290). However, generally favourable growing conditions were experienced throughout the year, as is evidenced by the heavy tonnages recorded.

Crop Yields.

Variety.	No. of Plots.	Cane per Acre.	C.C.S. in Cane.
		Tons.	Per Cent.
Co. 290	4	41·8	14·0
Comus	1	37·8	15·6
Jason	1	31·3	13·8
E. 1	1	27·2	14·5
E. 3	1	29·2	14·8
E. 6	1	36·0	15·4
E. 10	1	34·4	13·3
E. 12	1	47·1	15·7
E. 14	1	44·5	15·1
E. 15	1	52·8	13·5
E. 16	1	35·5	14·1
E. 18	1	36·2	14·9

DISCUSSION.

This trial was designed for the purpose of enabling preliminary observations to be made of the potential value of certain new seedling canes raised at Bundaberg, together with Comus and Jason, which were bred by the C.S.R. Company. Due to the distinct fertility variations which exist in the block, the only reliable means of assessing the worth of the canes is to compare each variety with the nearest plot of Co. 290.

Certain of the new canes are at least promising; E. 14 and 18 were planted in a further yield trial with Comus in 1938, while E. 12 will be so planted this year.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

VARIETAL TRIAL (Plant Crop).

Plan and Yields.

Q 23 29.4	Co 290 41.2	Q 22 40.8	Q 24 40.4	Q 25 50.4
Q 25 47.9	Q 24 34.2	Q 23 28.5	Co 290 42.3	Q 22 35.4
Q 22 38.7	Q 25 43.5	Co 290 38.7	Q 23 25.6	Q 24 34.4
Q 24 31.9	Q 23 25.6	Q 25 41.0	Q 22 31.9	Co 290 39.4
Co 290 37.5	Q 22 32.7	Q 24 29.6	Q 25 44.2	Q 23 26.4

Block.—D2.
Harvested.—November, 1938.
Age of Crop.—15 months.
Experimental Plan.—5 × 5 Latin square.
Plots.—0·065 acre (9 rows per plot, with guard rows of P.O.J. 234).

TREATMENT AND GROWTH NOTES.

A Poona pea crop was ploughed under in February, 1937, and the block was bare fallowed through the winter. Cane was planted in August. Conditions at the time of planting were dry, but rain fell shortly afterwards. Growth was rapid from the start, and only the dry spell of February caused any check.

All cane was fertilized uniformly with Sugar Bureau No. 3 planting mixture (2–8–25) at the rate of 4 cwt. per acre.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half $\log_e$ (Mean Square).
Rows	4	146·37	36·59	..
Columns	4	13·48	3·12	..
Varieties	4	923·53	230·88	2·7210
Errors	12	46·14	3·85	0·6740
Total	24	1,129·52	..	..

Standard Error = ± 0·88 tons cane.

Crop Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre
	Tons.	Per Cent.	Tons.
Co. 290	39·8	14·3	5·69
Q. 22	35·9	14·6	5·26
Q. 23	27·1	15·6	4·23
Q. 24	34·1	14·9	5·08
Q. 25	45·4	16·0	7·26

DISCUSSION.

The above results represent the first accurate yield data obtained for the varieties selected from the observational trial reported on p. 29. It will be noted that only one of the selected seedlings outyielded Co. 290 in this trial. But it so far exceeded it in both cane produced and C.C.S. that high hopes are held for the future of the variety.

Of prime importance at the present time, in the Bundaberg area, is the disease resistance of any new canes, due to the prevalence of both Fiji and downy mildew diseases. In disease trials to date, Q. 25 has shown high resistance to gumming and downy mildew diseases, but it is susceptible to Fiji disease; it can therefore only be planted where downy mildew is present but where Fiji is absent.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

PERMANENT TRASH TRIAL (First Ratoon Crop).

Plan and Yields.

No Trash.	Trash.	Trash.	No Trash.
34.7	38.2	40.8	34.7

Block.—E3b.

Variety.—P.O.J. 2725.

Harvested.—September, 1938.

Age of Crop.—13 months.

Plots.—0·382 acre.

TREATMENTS.

On the "trash" plots, all tops and trash from the plant cane were "rolled" into alternate interspaces; all crop residues were burnt on the "no-trash" plots. Ratooning was done by means of the subsoiler—on all interspaces of the "no-trash" plots, and on the bared interspaces of the "trash" plots. Fertilizing was carried out uniformly, apply Sugar Bureau No. 3 ratooning mixture (4·5 – 6·5 – 22·5) at the rate of 4 cwt. per acre, followed by a top dressing of sulphate of ammonia, 1½ bags per acre.

GROWTH NOTES.

The crop on all plots responded well to the favourable growing conditions. and throughout it appeared that the trash-covered plots carried cane superior in appearance of leaf and length of stalk.

Summary of Crop Yields—Plant and First Ratoon Crops.

Treatment.	Plant Crop.		First Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.
Trash	19·1	16·3	39·5	14·0
No Trash	18·6	16·7	34·7	14·5

DISCUSSION.

Four crops of cane have now been harvested from this interesting trial. No benefits were recorded with the first plant crop, while the ratoon following this was actually harmed by the presence of the trash mulch. The variety was Q. 813.

On planting with a hardier type (P.O.J. 2725), the plant crop showed a definite small gain on the plant crop, while the first ratoons, produced in a favourable growing season, showed a gain of 4·8 tons of cane per acre (see above). It would appear that the cumulative effects of trash conservation are at least showing up, and future returns will be most interesting.

A slightly depressed C.C.S. is evident in the results from the trash plots here recorded; it may be due to the increased notrogen content of the soil on which trash is conserved.

FERTILIZER TRIAL—FORMS OF NITROGEN AND PHOSPHATE.

(Second Ratoon Crop.)

Plan and Yields.

P_MK 25.0	K 25.0	N_AP_SK 19.2	P_SK 21.4	N_BP_MK 25.6
N_AP_SK 25.0	P_SK 21.6	K 20.8	N_BP_MK 22.6	P_MK 24.6
N_BP_MK 25.0	P_MK 21.6	P_SK 18.8	N_AP_SK 20.8	K 25.8
P_SK 24.8	N_BP_MK 22.6	P_MK 18.0	K 21.8	N_AP_SK 27.2
K 26.2	N_AP_SK 24.2	N_BP_MK 22.2	P_MK 22.0	P_SK 26.4

Block.—E3a.

Variety.—P.O.J. 2878.

Harvested.—August, 1938.

Age of Crop.—24 months.

Plots.—0·062 acre.

System of Replication.—5 × 5 Latin square.

TREATMENT AND GROWTH NOTES.

During the dry season of 1937 this second ratoon crop suffered severely; it was necessary to stand it over for another year. It failed to respond to favourable conditions during its second year of growth, due no doubt to the heavy mortality of mature sticks during the first year. Most of the canes harvested were actually suckers of the second season's growth. The field indeed cut out at some 12 tons per acre below the average yield for the Station, and it was the only standover crop harvested.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Fertilizer had been applied to the crop in the spring of 1937, at the following rates per acre:—

K = 200 lb. muriate of Potash.
$\mathbf{P_M}$ = 200 lb. meatworks manure.
$\mathbf{P_S}$ = 50 lb. sulphate of ammonia + 127 lb. superphosphate.
$\mathbf{N_B}$ = 225 lb. dried blood.
$\mathbf{N_A}$ = 153 lb. sulphate of ammonia.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ Log$_e$ (Mean Square).
Rows	4	8·98	2·25	..
Columns	4	125·82	31·46	..
Treatment	4	9·70	2·43	1·5952
Errors	12	9·01	0·75	1·0075
Total	24	153·51	..	..

Summary of Crop Yields—Plant, First and Second Ratoon Crops.

Treatment.	Plant Crop.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
K	21.3	14·1	17·7	14·4	23·9	13·4
P_MK	21·7	14·2	15·3	14·3	22·2	13·9
P_SK	19·9	14·1	17·0	14·2	22·6	13·7
N_BP_MK	20·6	14·4	17·4	14·2	23·3	14·3
N_AP_SK	19·8	14·0	17·1	14·3	23·6	13.4

DISCUSSION.

This trial was instituted to determine: (*a*) the relative values of organic nitrogen and that in the form of sulphate of ammonia; and (*b*) whether phosphate in the form of meatworks manure (bone) would be beneficial, even where no gains are experienced from superphosphate.

For the three crops harvested there is no evidence to warrant any conclusion other than that there has been no significant gain in yield from the use of either phosphate or nitrogen on this block in either of the alternative forms.

There may be some significance to the fact that the C.C.S. of the crop from the plots receiving nitrogen as dried blood was higher than that for other treatments, suggesting the value of organic nitrogen in preventing premature ripening of 2-year-old crops.

POTASH TRIAL (First Ratoon Crop).

Plan and Yields.

NPK 32.0	**NP** 30.3	**NP2K** 31.6	**NP** 30.3	**NP2K** 30.5	**NPK** 32.2
NP 31.6	**NP2K** 30.9	**NPK** 30.9	**NP2K** 29.9	**NPK** 30.5	**NP** 33.5
NP2K 34.3	**NPK** 33.7	**NP** 33.3	**NPK** 32.6	**NP** 32.4	**NP2K** 34.7

Block.—E2.

Variety.—Co. 290.

Harvested.—September, 1938.

Age of Crop.—12 months.

System of Replication.—2 — 3 × 3 Latin squares.

Area of Plots.—0·066 acre.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

TREATMENT AND GROWTH NOTES.

The block was ratooned by using the subsoiler three times per interspace. Growth was good throughout the year, except for the dry period during February. Fertilizer was applied, in accordance with the above plan, as follows:—

N = 225 lb. sulphate of ammonia per acre.

P = 225 lb. superphosphate per acre.

1K = 150 lb. muriate of potash per acre.

2K = 300 lb. muriate of potash per acre.

All phosphate and potash were applied at ratooning time, while the nitrogen was applied as a top dressing in November.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ Log_e (Mean Square).
Rows	4	21·87	5·47	..
Columns	4	13·48	3·37	..
Blocks	1	0·20	0·20	..
Treatment	2	0·30	0·02	0·3466
Errors	6	1·79	0·30	1·7006
Total	17	37·37	..	..

Summary of Crop Yields—Plant and First Ratoon Cr ps.

Treatment.	Plant Crop.		First Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.
NP	**13·1**	15·1	**31·9**	13·6
NP1K	**12·9**	15·0	**32·0**	13·2
NP2K	**13·3**	14·9	**32·0**	13·2

DISCUSSION.

The results presented above demonstrate the value of making, consistently, moderate applications of plant-food materials in which a particular soil may be deficient. The red volcanic soils of Queensland are generally in need of supplementary applications of potash, and these are made to all crops on the Bundaberg Station. It was decided, three years ago, to institute a permanent trial on which the effects of withholding potash or applying varying amounts could be studied in relationship to the productivity of the land.

For the two crops harvested from the area, no influence on yield can be detected either from applying or withholding this plant-food material. Evidently the soil reserves are ample for the production of a number of successive crops.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

VARIETAL AND QUANTITATIVE NITROGEN TRIAL (Second Ratoon Crop).

Plan and Yields.

POJ 2725.			POJ 2878.	
1N 38.2	0N 41.8	2N 45.9	2N 31.4	1N 26.1
2N 39.1	2N 38.0	1N 43.0	1N 31.1	0N 26.6
1N 41.4	1N 40.2	0N 41.6	2N 29.8	2N 28.9
0N 41.6	1N 39.3	2N 42.7	1N 28.9	2N 28.2
2N 35.7	2N 43.4	1N 40.2	0N 25.5	1N 26.8

Block.—A1.
Varieties.—P.O.J. 2725 and P.O.J. 2878.
Harvested.—October, 1938.
Age of Crops.—13 months.
Plots.—0·055 acre.

TREATMENT AND GROWTH NOTES.

After harvesting the first ratoon crop the trash and tops were rolled into alternate interspaces, on top of the partially decomposed residues from the plant crop, which had been similarly conserved. Ratooning was done on the bared interspaces by means of the single-tyne subsoiler. Sugar Bureau No. 3 ratooning mixture (4·5-6·5-22·5) was applied to all plots at the rate of 5 cwt. per acre, and sulphate of ammonia was applied (as shown on the plan) as a top dressing.

Formerly, the treatments were 0N, 1N, 2N, 3N, and 4N; for the second ratoon crops this was modified, so that former 1N and 2N plots each received 120 lb. of ammonium sulphate per acre, while 3N and 4N plots were uniformly treated at the rate of 240 lb. per acre.

Although earlier crops had been irrigated, the second ratoons were produced by natural rainfall only, due to water shortage at the pump.

Growth conditions were favourable, except for the dry, hot spell experienced in February, 1938.

Summary of Crop Yields—Plant, First and Second Ratoon Crops.

Treatment.	Plant Crop.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
0N	57·7	12·6	40·9	16·6	35·4	16·8
*1N	56·1	12·6	44·2	16·0	35·6	16·5
*2N	59·5	13·2	41·4	16·1	35·4	16·7
†3N	61·6	12·9	40·7	16·1	35·3	16·7
†4N	55·0	13·1	43·8	15·7	37·3	15·8

* Uniformly 120 lb. A.S. per acre for second ratoons.
† Uniformly 240 lb. A.S. per acre for second ratoons.

DISCUSSION.

This experiment, which is now concluded, marks an attempt to induce nitrogen deficiency in the red volcanic loam by intensive cropping methods. Yet, in spite of the removal of more than 135 tons of cane per acre, during a period of three years, there is little, if any, benefit apparent from applications of sulphate of ammonia. On the second ratoon crop, the plots which received the heaviest nitrogen dressings do appear to have given a slight increase in cane yield, but this has been accompanied by a depressed C.C.S. in first and second ratoon crops.

One must, therefore, conclude that the nitrogen reserves of this soil are still quite fair, after many years of cultivation. Doubtless, green manuring and moderate applications of sulphate of ammonia have contributed to this condition, and one would also anticipate, eventually, a definite need for artificial manures rich in nitrogen, if the intensive cropping methods employed above were continued. That all trash was conserved would also contribute to the nitrogen supply for the ratoon crops.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Though not to be regarded as a well-controlled varietal trial, the "single plot" comparisons for P.O.J. 2725 and 2878 are interesting:—

Variety.	Plant Cane.		First Ratoon Crop.		Second Ratoon Crop.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
P.O.J. 2725	63·0	12·3	46·6	16·5	41·3	16·7
P.O.J. 2878	50·5	13·8	35·6	15·5	28·3	16·2

The data endorse experiences elsewhere in the district, where these canes are grown by irrigation. P.O.J. 2725 is, under these conditions, superior on soils of this type. Of course, the susceptibility of P.O.J. 2725 to annual arrowing is a serious drawback, if the production of standover crops is the practice. On this trial, it has excelled the "Wonder Cane" in both tonnage and average C.C.S.

FACTORIAL FERTILITY TRIAL (Plant Crop).

Plan and Yields.

1N 1P 0K 34.1	2N 1P 1K 36.9	0N 2P 0K 34.7
2N 2P 2K 38.6	0N 0P 1K 30.8	1N 0P 2K 34.9
0N 1P 2K 35.6	1N 2P 1K 34.5	2N 0P 0K 33.9
2N 0P 1K 34.1	0N 1P 0K 33.6	1N 2P 2K 32.1
0N 0P 2K 34.7	1N 0P 0K 32.7	2N 2P 0K 32.5
1N 1P 1K 36.0	2N 1P 2K 33.8	0N 2P 1K 36.0
0N 1P 1K 40.3	1N 2P 0K 36.8	2N 2P 1K 34.9
2N 1P 0K 37.3	0N 0P 0K 35.1	1N 0P 1K 34.9
1N 1P 2K 32.3	2N 0P 2K 36.0	0N 2P 2K 35.3

Block.—B1.

Harvested.—September, 1938.

Age of Crop.—19 months.

Variety.—Co. 290.

Plots.—0·067 acre.

TREATMENTS AND GROWTH NOTES.

A good crop of Poona pea was ploughed under in early January, 1937, and decomposition was complete at the time of planting in February. Fertilizer was applied in the drill at the following rates per acre:—

1P = 400 lb. superphosphate.
2P = 800 lb. superphosphate.
1K = 180 lb. muriate of potash.
2K = 360 lb. muriate of potash.

Nitrogen was applied subsequently, as top dressings, at the following rates per acre:—

1N = 120 lb. ammonium sulphate.
2N = 240 lb. ammonium sulphate.

One application of nitrogen was made in September, and a second dressing to the 2N plots in December.

Most of the early part of 1937 was dry, and crops made little headway during the autumn, winter, and early spring. From October, onwards, growth conditions were quite good, with the exception of February, 1939, when little rain fell and hot conditions prevailed.

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Crop Yields—Plant Cane.

Treatment.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
	Tons.	Per Cent.	Tons.
0N	35·1	12·7	4·46
1N	34·3	12·4	4·25
2N	35·3	12·5	4·41
0P	34·1	12·5	4·26
1P	35·5	12·5	4·44
2P	35·0	12·5	4·38
0K	34·5	12·8	4·42
1K	35·4	12·5	4·43
2K	34·8	12·3	4·28

DISCUSSION.

The factorial type of trial is one which is rapidly coming into favour with the agriculturist, as it permits him to obtain a maximum of desired information, with a high degree of reliability, and without recourse to an exceptionally large number of plots per trial.

The experimental results reported herewith are the returns from the first trial of this type harvested on a Sugar Experiment Station. In this instance, it will be observed that no positive crop gains have been recorded for any of the added plant-foods. It does appear, however, that the heavy applications of potash have resulted in a decrease in C.C.S. of the crop when it was cut. This can only be interpreted to mean that the cane on these plots was over-mature when harvested.

Crop Summary.

	Tons	cwt.	qr.
Cane sent to mill	789	3	1
Cane cut for plants	6	5	0
Cane used for samples	3	0	0
Total	**798**	**8**	**1**
Total area harvested	**23.04 acres.**		
Tonnage per acre harvested	**34.65.**		

The above figures constitute not only a record total tonnage for the Experiment Station, but also a record tonnage per acre. It should be explained that of the above area only 1·3 acres was standover, and this crop was a very poor one of only 27 tons per acre. Irrigated cane consisted of 2 acres of seedlings, the remainder of the station crop being unirrigated.

An analysis of crops harvested shows age classes as follows:—

Standover cane	1·30 acres
Plant cane	9·17 acres
1st ratoons	6·61 acres
2nd ratoons	5·96 acres

Work of the Southern Sugar Experiment Station, Bundaberg—continued.

Laboratory Work.

Analytical work for the year under review included:—

Experiment Station cane samples	335
Farmers' cane samples	342
Irrigation waters	85
Total	762

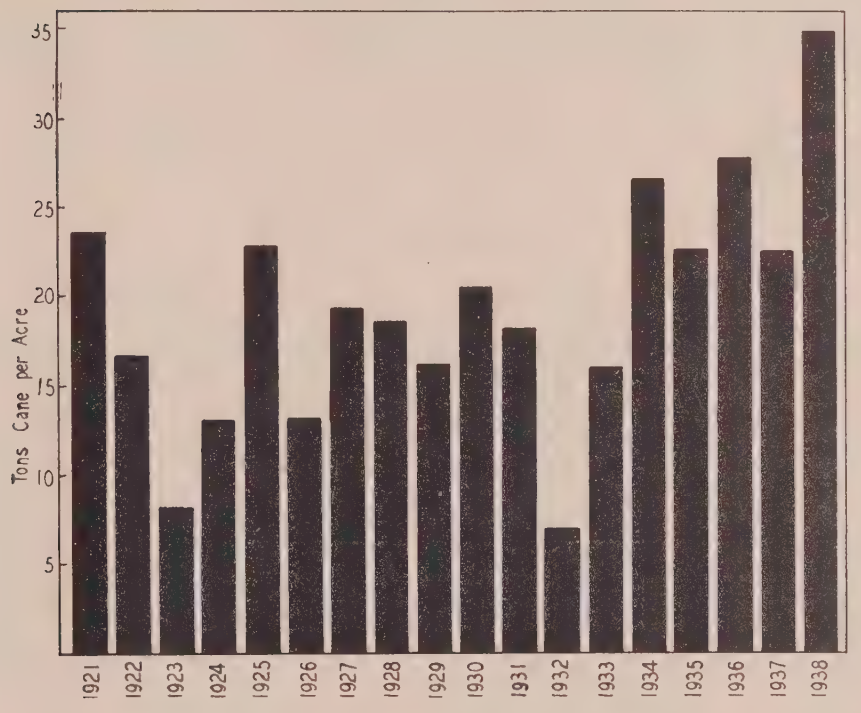

Fig. 2.—This graph illustrates the striking manner in which recent varietal introductions and the control of gumming disease have affected yields at the Bundaberg Station. Following the 1932 drought, the rapid expansion in plantings of P.O.J. 2725 and 2878 and Co. 290 on the Station, has increased average yields about 50 per cent. over those of the preceding ten years. Little or no standover cane is grown on the Station in any year.

REPORT OF COMMITTEE ON SEEDLING PROPAGATION.

Mr. Arthur F. Bell, Assistant Director, *Chairman.*

Seedling propagation and selection was continued along the lines set out in the previous Annual Report. During the period under review a new glasshouse was completed at Mackay. The equipment at the three Stations is now complete with glasshouses, concrete seedling benches, sterilizers, mulch pits, &c. The current programme provides for the raising of approximately 22,000 seedlings annually, distributed between the three Stations.

1939 Cross Pollination Season.

In marked contrast with conditions prevailing during the previous two years the 1939 wet season yielded heavy falls of rain over an extended period, comparative precipitation for the years 1937-9 being as under:—

	1937 in.	1938 in.	1939 in.
January	8	19	26
February	5	19	37
March	16	3	35
April	5	0·5	9
Total	34	41·5	107

Although the factors conditioning arrowing are little understood it is obvious that, in North Queensland at least, the intensity and duration of the wet season has a very considerable influence. As reference to previous Annual Reports will indicate, the years 1937 and 1938 were years of extreme paucity of arrows; 1939 on the other hand, has been a year of heavy arrowing, while arrows appeared some two weeks earlier than in 1937 and 1938. Practically all varieties arrowed more freely this year, not only in the recognised free-arrowing districts in close proximity to the sea, but also in those poorer arrowing areas which are separated from the sea by low mountain ranges. Quite a number of usually poor-arrowing canes produced numerous tassels, and actually Q. 813 was the only standard variety which failed to arrow.

The favourable arrowing situation allowed a large number of crosses to be made, but germination figures are not yet to hand. It was noted, however, that the arrows did not keep nearly so well as in previous years of poor arrowing, and this particularly applied to arrows kept in solution. It therefore seems likely that a considerable compensating factor may operate. Crosses were carried out according to the subjoined table:—

Female Parent.	Male Parents.
Co. 421	20S16, P.O.J. 2940
Co. 270	P.O.J. 2940, "X" 9
Co. 290	P.O.J. 2878, "X" 2, Q. 1098
Co. 235	Q. 1098
Juno	S.W. 499, "X" 1, Co. 356, Q. 10
Korpi	"X" 1, "X" 2, "X" 13, H.Q. 409, Co. 290, S.W. 499, J.B. 1, "X" 5, S.C. 12/4, N.G. 15
Nanemo	H.Q. 409, "X" 13
N.G. 15	J.B. 2, 7R428, "X" 2, "X" 13, "X" 1, J.B. 8, P.O.J. 2878, S.C. 12/4, "X" 14, "X" 6, H.Q. 409, S.W. 499, E.K. 28, Co. 290, 20S16, "X" 5, M. 1900S, Q. 2
Oramboo	"X" 9, "X" 13, H.Q. 409
P.O.J. 100	7R428, "X" 12, 20S16, M. 1900S, "X" 7, P.O.J. 2940
P.O.J. 213	"X" 2, "X" 9, "X" 12, H.Q. 409
P.O.J. 234	P.O.J. 2878, E.K. 28, "X" 2, "X" 5
P.O.J. 2364	D. 1135, 20S16, Co. 356, S.W. 499
P.O.J. 2725	D. 1135, 20S16, "X" 12, "X" 9, Co. 290
P.O.J. 2727	"X" 9
P.O.J. 2883	Co. 356, 20S16, "X" 6, H. Q. 409
P.O.J. 2875	Co. 356, 20S16, H.Q. 409, "X" 6
P.O.J. 2878	20S16, "X" 7, "X" 9, "X" 12, "X" 13, Co. 290, Q. 1098, S.C. 12/4, N.G. 15
Saretha	"X" 2
S.J. 4	20S16, P.O.J. 2878, "X" 9, "X" 7, Ewa 371, E.K. 28, H.Q. 409, "X" 2, S.W. 499, "X" 13, "X" 8, Q. 21, Co. 290, "X" 1, "X" 14, S.C. 12/4, Co. 419, J.B. 1, J.B. 11, N.G. 15, Q. 2
"X" 8	Q. 1098
"X" 10	Q. 1098, "X" 13, "X" 2, Co. 290
J. 36	E.K. 28
J. 34	J.B. 1
J.B. 4	Co. 419
J.B. 7	"X" 9
J.B. 8	"X" 5, N.G. 15
Uba	"X" 2, "X" 5
U.D. 39	S. W. 499

Report of Committee on Seedling Propagation—continued.

The varieties designated by X., J., and J.B., represent local seedlings the utility of which as breeding canes is not yet sufficiently well established to warrant their being advanced to the "Q" series. It is of interest to note, however, that X. 1 and X. 14 are half *robustum* seedlings, while J.B. 2 is a hybrid between Co. 515 (half sorghum) and P.O.J. 2940. Co. 515 carries some obvious sorghum characteristics, and the crossing of the quarter sorghum back on to N.G. 15 (Badila) is of interest.

In addition to the above a first nobilization of *S. spontaneum* Tank and an intergeneric cross with *Erianthus arundinacearum* were attempted.

Male arrows were maintained in solution (·01 per cent. SO_2 + ·01 per cent. H_3PO_4) in all crosses; in a proportion of the crosses the female arrow was left growing in the field, but in the majority the female arrows were also maintained in the above solution. The solution crosses were set up in a compact area in a belt of light forest on the Meringa Station. The ripe fuzz was usually dried, in a specially constructed dryer, by a forced draught of heated air, thus obviating delays between harvesting and packing in periods of wet weather. Following successful storage experiments last year it is proposed to store a considerable amount of fuzz this year for trials with early germination of seed in 1940.

1938 Series Seedlings.

Between nineteen and twenty thousand original seedlings were planted out on the three Stations, the number of crosses represented in these field plantings being Meringa, 22; Mackay, 24; Bundaberg, 13. Fuzz from selfed arrows was germinated at Meringa in order to determine the probable amount of selfing in controlled crosses; in certain cases seedlings from such selfs were transferred to the field for observation and/or selection.

The very poor arrowing in 1938 did not permit a wide range of crosses being made, but crosses with the varieties P.O.J. 213, 2725 and 2878, and Co. 290 yielded large numbers of seedlings. The requirements of the Southern district, where these varieties predominate, were accordingly satisfactorily filled. On the other hand the scarcity of arrows among canes of the Badila type has resulted in a shortage of desirable types for selection at Meringa this year. The cross P.O.J. 2878 x Co. 290 has again produced a very attractive looking lot of seedlings at the Bundaberg Station and, if the disease reactions of this progeny prove at all satisfactory, it should prove a valuable cross. Steps have been taken to include one hundred seedlings of this cross in both downy mildew and Fiji disease-resistance trials in the coming spring. A considerable amount of mass planting was carried out with surplus flats of seedlings, and the planting of selections from these will be watched with interest.

Selected Seedlings.

Last year we intimated that it was proposed to discontinue the practice of planting 1-row, 10-sett plots of second-year seedlings and four such plots of third-year seedlings, but rather to combine these and plant out 40-sett (4 rows x 10 setts) plots in the second year. This practice was followed in the last planting, and it can be said without hesitation that the practice promises to put the second selection of seedlings on a much more satisfactory basis. This method of planting has enabled valuable notes to be made on the early cover and growth habits of the seedlings, while the systematic interplanting of standard plots would seem to permit of sound comparisons of growth being made. Such selections will be made during the next couple of months.

The 1937 series seedlings were rather rigorously selected since they were combined, at least in part, with re-selections from the 1936 seedlings in the new system of 40-stool plantings. Combined selections for this purpose were as follows:—Meringa, 82; Mackay, 73; and Bundaberg, 45. The most promising families from which these selections were made were S.J. 4 x 20S. 16 and Badila x (Black Cheribon x *S. robustum*) at Meringa, Badila x S.C. 12/4 at Mackay, and P.O.J. 2878 x Co. 290 at Bundaberg. The cross Badila x (Black Cheribon x *S. robustum*) gave a very attractive population except for the fact that eyes were generally not good and trash was inclined to cling. As mentioned elsewhere the cross P.O.J. 2878 x Co. 290 is very promising for Bundaberg conditions, as judged by visual characters.

Yield observation trials (1/20 acre plots) were planted on all three stations as follows:—Meringa: G. 113, 118, 126, 140, 243, and H. 248; Mackay: F. 21, 31, 40, 57, and 58, G. 5, 8, 17, 18, 19, 20, 22, 39, 52, and 58; Bundaberg: F. 10, 19, 20, 21, 22, 23, 25, 26, and 28. Latin Square variety trials were also planted at Mackay (E. 4, E. 45, F. 18, and Comus with Q. 813 as standard) and Bundaberg (C. 12, E. 14, E. 18, and Comus, with Co. 290 as standard). Results from these trials will be obtained during the coming harvesting season; results from previous yield-observation and Latin Square trials will be found elsewhere in this report in the record of trials conducted on the respective Stations.

Report of Committee on Seedling Propagation—continued.

Q. Seedlings.

The seedling **Q. 2** is now on the approved variety list for northern mills and is being propagated for test in Central Queensland; its susceptibility to gumming and downy mildew diseases under South Queensland conditions preclude its growth there.

The following are brief notes on the Q. seedlings which have shown promise in farm trials:—

Q. 10 has shown promise of early maturity and high sugar content, is a good striker and fair to good ratooner. It is more resistant to borers than Badila but equally as susceptible to grubs. It is resistant to gumming, top rot, and leaf-scald under North Queensland conditions. Its chief drawbacks are its lodging characteristic, a tendency to shoot at the top, and susceptibility to rat damage. It will probably be approved for planting in certain northern districts in 1940.

Q. 13 so far shows improved performance as compared with Q. 10 in the matter of sugar content and early maturity and habit of growth. It is resistant to gumming and leaf-scald, but susceptibility to top rot is of the Badila class. In the absence of top rot it is resistant to borers, and its harder rind and more erect habit make is less attractive to rats. It is a good striker, and if ratooning is satisfactory it should be a useful cane; it will be extensively tested in North Queensland during the 1939-1940 season.

Q. 19 is still under test but will probably be discarded on account of disease susceptibility. Furthermore, although an attractive looking cane it is late maturing and not then of high sugar content.

Q. 20 is a cane of the Q. 813 type which has performed promisingly in the Mackay district. It is a rather early maturing cane of high sugar content; yields are not heavy but ratooning is comparatively strong. The growth habit is sprawling but the cane does not lodge badly; cover in the early stages is not particularly good. In trials conducted to date it appears resistant to gumming and downy mildew diseases and reasonably resistant to top rot. The variety is being extensively planted experimentally in the Mackay district and will probably be gazetted an approved variety for that area in 1940. Yield trials or farm observation trials with this variety have been set out in North and South Queensland and the Lower Burdekin district.

Q. 23 has shown fairly good resistance to downy mildew disease. It is a lighter cropper than Co. 290, but so far has averaged about 1½ units higher in C.C.S., and will therefore receive further trial.

Q. 25 performed well on the Bundaberg Station, both as to vigour and sugar content. It is resistant to gumming disease and apparently highly resistant to downy mildew, for which reason it will be tested extensively in farm plots in the Bundaberg district this season. It is susceptible to Fiji disease. Small supplies of this cane have been sent to other areas.

Q. 27 is a hard vigorous cane which has shown some resistance to grub damage and therefore will be tested further, although sugar content is on the low side.

Q. 28 will be advanced to farm trial in the Mackay district this year. It is vigorous and fairly resistant to downy mildew, but sugar may be low.

Q. 29 did not arrow in the Cairns district this year, and, moreover, has a hard rind. It therefore has two very important requirements of a standover cane and consequently will be further tested.

Other Q. varieties mentioned in last year's report—viz., Q. 21, 22, 24, and 26—have now definitely been discarded after further trial.

Other Varieties Advanced to Farm Trial.

No overseas varieties are undergoing trials on farms at the time of writing. The following are seedlings raised by the Colonial Sugar Refining Company either in New South Wales or at Ingham:—

Jason.—This variety has proved highly resistant to all diseases to which it has been exposed. Its growth habit is of the standover type in Southern Queensland, where it is now being tested, but its free arrowing precludes its use for this purpose in Mackay and north. It is not an impressive looking cane, but has yielded good tonnages in the Northern Rivers of New South Wales as a standover crop. However, the sugar content appears to be in the vicinity of a unit of C.C.S. below P.O.J. 2878 and the purity also appears low.

Report of Committee on Seedling Propagation—continued.

Comus, is a one-year type of cane of reputed high sugar content and early maturity. It is resistant to downy mildew but highly susceptible to mosaic and Fiji diseases. It will be further tested in all areas.

Juno is a vigorous cane of probably fair sugar content. It is resistant to gumming disease in North Queensland, but probably too susceptible to leaf-scald to be grown in the bad leaf-scald areas south of Aloomba. In the Ingham district, where it is a minor standard, it is reputed not to ratoon well if cut in cool weather. This variety may prove of value in gumming disease areas of North Queensland.

Brutus and **Vulcan** are two somewhat similar types, giving good individual stalks but rather poor stooling. They are being further tested, but at the present time we do not anticipate that they will become commercial canes in North Queensland. Both are reasonably resistant to gumming and leaf-scald but susceptible to top rot. They have so far indicated rather high sugar content and earlier maturity than Juno.

Varietal Statistics.

Reliable statistics are an essential economic yardstick in any industry seeking the highest stage of efficiency. In order to provide for adequate statistical information regarding distribution and relative yield of varieties the 1938 Amendment Act requires each canegrower to return each year a form setting out the area of each variety harvested or planted during the preceding calendar year. A preliminary census of varieties planted and harvested in 1938 was taken this year, but this section of the Act will be strictly applied next year.

One interesting feature revealed by the current returns is that in the districts of Bundaberg and south, planting during the 1938 season was virtually restricted to the three varieties, Co. 290, P.O.J. 213, and P.O.J. 2878. This completes the varietal revolution in Southern Queensland, the progress of which is illustrated in Table I.

TABLE I.

Tonnages and Per Cent. by Tonnage of Varieties Crushed, Bundaberg and South, 1933–38.

Variety.	1933.		1934.		1935.		1936.		1937.		1938.	
	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.
D. 1135 ..	134,000	21·0	183,000	22·6	171,000	19·2	98,000	12·5	48,000	7·6	32,000	3·1
1900 S. ..	75,000	11·7	110,000	13·6	95,000	10·7	73,000	9·3	38,000	6·1	42,000	4·1
Q. 813 ..	97,000	15·1	73,000	9·0	77,000	8·6	57,000	7·2	27,000	4·3	36,000	3·6
Uba ..	99,000	15·4	58,000	7·2	79,000	8·9	43,000	5·5	24,000	3·8	12,000	1·2
Co. 210 ..	48,000	7·5	42,000	5·1	46,000	5·1	23,000	2·9	13,000	2·1	6,000	0·6
M. 189 ..	37,000	5·7	57,000	7·1	31,000	3·4	17,000	2·1	5,000	0·8	4,000	0·4
H.Q. 285 ..	41,000	6·3	38,000	4·8	35,000	3·9	23,000	2·9	13,000	2·1	14,000	1·4
Oramboo ..	14,000	2·2	21,000	2·5	39,000	4·4	28,000	3·6	24,000	3·8	21,000	2·1
Mahona ..	13,000	2·0	23,000	2·9	14,000	1·6	10,000	1·2	4,000	0·7	7,000	0·7
Q. 1098 ..	14,000	2·2	9,000	1·1	7,000	0·7	12,000	1·6	3,000	0·5	5,000	0·5
Korpi ..	..	..	7,000	0·9	6,000	0·7	8,000	1·0	15,000	2·3	15,000	1·5
P.O.J. 213 ..	22,000	3·5	60,000	9·4	101,000	11·3	131,000	16·7	94,000	14·8	143,000	14·0
P.O.J. 2714 ..	5,000	0·8	27,000	3·3	41,000	4·6	30,000	3·8	20,000	3·1	22,000	2·2
P.O.J. 2878 ..	4,000	0·6	53,000	6·6	86,000	9·7	133,000	16·9	142,000	22·5	331,000	32·6
P.O.J. 234 ..	..	..	..	..	12,000	1·3	24,000	3·0	27,000	4·3	42,000	4·1
Co. 290 ..	..	..	..	..	5,000	0·6	43,000	5·4	99,000	15·6	228,000	22·4
Aggregate Percentage	..	94·0	..	94·1	..	94·7	..	94·6	..	94·4	..	94·5
Total Tonnage	640,836	..	808,951	..	890,262	..	783,899	..	633,250	..	1,017,716	..

A study of this table reveals the interesting fact that if a line be drawn above P.O.J. 213, the varieties below this line advanced from 4·9 per cent. of the crop in 1933 to 75·3 per cent. in 1938. It is expected that they will constitute more than 90 per cent. of the 1940 crop.

Report of Committee on Seedling Propagation—continued.

Experimental.

In furtherance of investigations into the use of SO_2-H_3PO_4 solution for the maintenance of both female and male arrows during crossing, some 20 crosses were carried out wholly in solution. Fourteen of these were duplicated by set-ups in which the female arrow was left growing in the field and in no case was the amount of seed obtained from the solution cross less than the field-solution cross, while in at least three cases there was much greater production of seed in the former. Under the conditions operating in the 1938 season, therefore, the use of solution for both parents is most promising, but it remains to be seen whether this holds for other seasons and all varieties.

An interesting result was obtained from one cross—S.J. 4 x (Black Cheribon x *S. robustum*)—in which solution crosses were set up in sun, full shade, and partial shade as a preliminary test of effects of shading. Partial shade was provided in uncleared forest, while full shade was provided by projecting the arrows up into the lower branches of a mango tree. The number of seedlings obtained per unit weight of fuzz were:—Open sun, 490; forest, 680; under mango tree, 1450. It would seem that the still and humid atmosphere obtained under the heavy foliage more than compensated for any possible deleterious effect of shade.

The transport of arrows from distant fields was investigated, and it is evident that the provision of a lidded box, 12 feet long, mounted horizontally on a motor truck, enables transport of large numbers of arrows without damage; about one foot of stalk is removed before placing the arrows in solution.

An attempt was made to stimulate arrowing by pouring 10 c.c. of a saturated aequeous solution of acetylene into the heart of stalks of cane. The variety chosen was Badila, and applications were made between November and May. No stimulation became apparent.

A suitable box dryer for the drying of ripened arrows in wet or humid weather was developed during the year. The dryer consists of a well-made wooden chamber 6 feet x 3 feet x 1 foot, the air current being provided by a 12-inch variable speed electric fan driving air through a short tunnel across which is placed an adjustable heating element. The fuzz is suspended in bags from a metal rod set just beneath the overlapping lid. Movable baffles and thermometers placed at intervals permit the development of even temperatures and air movement.

A further series of fuzz storage experiments was carried out. Fuzz from (*A*) a very strong germinator (selfs of Co. 356), and (*B*) a weak germinator (Black Cheribon x *S. robustum*) were stored at room temperatures and 32°C. and 55°C. for seven months in atmospheres of air and CO_2. In order to check the effect of short delays before storage, one portion of the fuzz was not placed in storage until some ten days after collection, and after-storage delay obtained by making a second planting of all fuzz four days after removal from storage. Counts of seedlings were made some ten and twenty days after planting, previous experience having shown that if seedlings survive 18-20 days after planting they will persist. Counts on the basis of the number of seedlings per 10 grams of fuzz planted are set out in Table II.

TABLE II.

Numbers of Seedlings per 10 gm. Fuzz Planted after Storage under Varying Conditions.

Fuzz.	Temp. Deg. C.	Storage Atmos.	First Planting.		Second Planting.	
			10 Days.	20 Days.	10 Days.	18 Days.
A	32	Air	2,748	2,356	3,490	3,178
A	32	Co_2	2,666	2,540	3,316	3,328
A	55	Air	2,270	2,082	2,686	2,864
A	55	Co_2	1,852	1,616	3,030	3,468
A	Room	Air	1,630	126	2,022	64
A (delayed)	32	Air	2,982	2,894	..	..
A (storage)	55	Air	3,324	3,262	..	..
B	32	Air	147	147	169	162
B	55	Air	149	135	172	152
B	Room	Air	15	0	1	0

Without placing too much stress on actual figures it nevertheless seems reasonable to conclude that, under the conditions of this experiment—

(*a*) Cool to cold temperatures favour maintenance of germinating capacity and, more particularly, capacity to survive after germination.

(*b*) As was the case in the previous season's trials, the substitution of an atmosphere of CO_2 appears to have no value.

(*c*) A short delay before storage, or between storage and planting, appears beneficial rather than deleterious.

During the coming season a considerable number of crosses will be stored for germination after about nine months storage. The questions of solution crosses and the use of crossing lanterns will also be studied extensively.

Report of the Division of Entomology and Pathology.

Mr. Arthur F. Bell, Assistant Director.

During the period under review the outstanding advance from the point of view of disease control, and to a less extent pest control, has been the comprehensive amending of existing legislation by the passage of *"The Sugar Experiment Stations Acts,* 1900 *to* 1938." Although this Bill may be considered by some as conferring over-wide powers, its reception, not only by responsible leaders of the sugar industry, but by the industry as a whole, leaves no doubt as to the necessity and desirability of such legislation.

No extension of areas of depredations of pests occurred and, in general, economic losses were on a smaller scale than during 1937-38. The disease situation showed a general improvement with the exception of downy mildew in the Bundaberg district; as will be seen below, this latter problem is being attacked locally with exceptional vigour. Recent surveys indicate that gumming disease has extended from Mulgrave into the variety S.J. 4 in the Hambledon Mill area; the full extent of the outbreak is not yet known, but it is probable that the highly-susceptible S.J.4 will have to be discarded. Fortunately, comparatively few varieties are highly susceptible to this disease in the northern tropics.

The Amended Sugar Experiment Stations Act.

"The Sugar Experiment Stations Acts, 1900 *to* 1938" received assent on 27th October, 1938. It had long been felt that the special conditions, imposed by the wide array of serious sugar-cane diseases present in Queensland, demanded special legislative treatment. This particularly applied to variety control, since a recrudescence or fresh outbreak of any particular disease was usually traceable either to its persistence in a small area of an otherwise discarded susceptible variety, or to unofficial introduction of varieties from another district. Under the provisions of this Amendment Act sugar-cane is excluded from the scope of the Diseases in Plants Act and all powers for disease and pest control in respect of sugar-cane are now vested in the Director of Sugar Experiment Stations. The chief features of this legislation as applied to disease and pest control are as follows: —

1. The Director is required to issue each year a list of the varieties of sugar-cane which are approved for planting within each mill area. Such varieties, even though subsequently disapproved for planting, remain approved for cultivation for three years after the year of planting. Any person who grows, or has in his possession, any variety other than an approved variety is liable to a substantial penalty; furthermore, any sugar mill which accepts delivery of any variety not approved for its particular district also incurs a substantial penalty. In preparing the lists of approved varieties the Director is required to have regard to the resistance to disease, the agricultural qualities, and the milling characteristics of each variety.

2. Provision is made for the production, introduction and cultivation of experimental varieties under the authority of the Director; the unauthorised possession of experimental varieties carries very heavy penalties.

3. The State is divided into ten sugar-cane quarantine districts, and the removal of sugar-cane from one such district to another is prohibited unless a special permit is issued. Owing to the importance of this factor in disease dissemination, and the difficulty of detecting the transfer of small parcels of cane, the Act provides that where there is reason to suspect that any particular cane has been introduced in contravention of this section the owner thereof may be called upon to prove that the cane in question was not illegally introduced into that quarantine district; in the event of his failing to do this he shall be guilty of an offence against the Act.

4. The Act contains adequate provision for the inspection of canefields, buildings, &c., and treatment and/or destruction of diseased cane and infective material. Sugar-cane is defined as "any plant or part of a plant of the genus *Saccharum* or any hybrid therefrom or therewith"; the term "diseased" is defined as "affected with disease or liable, by reason of having been in proximity, to be affected with disease."

5. Provision is made for the declaration of quarantine areas under various conditions. In the event of an illegal transfer of cane from or into a quarantine area the following persons commit an offence:—The owner (or occupier) of the land *from* which the cane is removed, the owner of the land *to* which the cane is removed, and the person who actually makes the removal.

Report of the Division of Entomology and Pathology—continued.

6. Any area may be declared cane disease and/or cane pest infested and Cane Disease Control Boards and Cane Pests Boards respectively may be constituted therein. These Boards, composed of millers and growers, are financed by compulsory levy and are charged with the responsibility of implementing disease or pest control measures as the case may be.

7. Provision is made for the collection of such statistics as may be required of millers and growers.

8. Cane grown for fodder purposes within a mill area must be of stipulated varieties.

9. All cane grown in contravention of the provisions of the Act becomes *ipso facto* diseased cane and may be destroyed forthwith.

10. Provision is made for the payment of compensation for destruction of cane (not included in paragraph 9 above), in approved instances, by Cane Disease Control Boards.

Cane Pests Boards and Cane Disease Control Boards.

Cane Pests Boards, constituted under the Act and composed of three growers' and two millers' representatives, have operated for some years, and such have been constituted in Mossman, South Johnstone, Tully, Victoria, Invicta (Ingham line), Invicta (Giru), Pioneer, Kalamia, Inkerman, Mackay, Plane Creek, and Isis Mill areas. There are, in addition, a number of older voluntary Pest Boards still in existence.

Since the passing of the 1938 Amending Act, Cane Disease Control Boards have been constituted for the Mulgrave, Mackay, Bundaberg, Isis, Maryborough and Moreton districts; steps have also been taken to declare the Mossman and Hambledon Mill areas to be cane disease infested.

It is proposed that all such Boards should employ supervisors, together with such assistants as may be desirable. In the matter of disease control the efforts of the Boards will be directed mainly towards disease detection, and the control of such diseases as are controllable by inspection and roguing—such as Fiji and downy mildew diseases.

Cane Pest Boards Conference.

The fifth annual conference of Cane Pests Boards was held at Mackay on 9th June, and was attended by representatives of fourteen Boards and the Bureau of Sugar Experiment Stations. Some dozen papers on various aspects of cane-pest control were presented. Particular interest was centred on a demonstration of a new form of soil fumigant injector which had been developed by a canegrower with a flair for mechanics. This injector shows considerable promise in the direction of improved and cheaper injection, and will probably be widely tested under commercial conditions during the 1940 grub season. It was resolved to hold the 1940 Conference in Ayr.

The Greyback Cane Beetle (*Lepidoderma albohirtum* Water.).

Throughout practically all the mill areas north of Townsville there was an appreciable if not altogether unexpected increase in grub infestations in canefields which normally suffer from visitations of this kind. It has been pointed out in previous reports that grub populations have been building up gradually during the past few years; consequently, with weather conditions during October-December, 1938, favourable for beetle emergence, followed by continued monsoonal rains in the early part of 1939 making conditions even more favourable for survival of the insect in the critical egg and early larval stages, it was only logical to expect that there would be a substantial increase in grubs in the vicinity of the previously recorded foci of infestation. Such has been the case; in fact, damaged cane was evident in places where beetles were relatively scarce during the flighting season, thus indicating a fairly high survival ratio.

If the rainy conditions were so favourable for the grub pest, they also favoured the infested cane which was thereby kept alive and growing for a longer period, and suffered less deterioration than would otherwise have been the case if dryer weather had prevailed. Actually the cane showed little distress until the rains ceased, and then the characteristic yellowing and browning of the damaged cane soon became apparent. In some areas wholesale uprooting of the stools occurred, and many of the fields will have to be ploughed out, but in most cases the damaged cane was able to be milled, and in consequence an absolute loss did not result.

In those areas where soil fumigation is an old established practice, the increase in the acreage fumigated over that of last year varied from 100 per cent. to 400 per cent., whilst in some of the areas where this form of control is not so well known, trial plots were established and neighbouring growers have since signified their intention of fumigating their crops next year should there be a recurrence of this trouble.

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Reference was made previously to damaged cane appearing in places where the number of beetles seen on the wing was comparatively few, and any grub infestation was entirely unsuspected until the cane yellowed. By then, most of the roots had obviously been pruned from the stools, but, in many cases, fumigation was resorted to; although the grubs were killed the cane made little or no further growth, and under such circumstances this form of control then becomes a proposition of very doubtful economic value. To ensure continued growth of cane, grubs must be fumigated during their second or early third stages, before any serious root pruning has occurred. Increased importance must, therefore, be attached to the early grub survey work, for only by locating the infested areas and fumigating them at the optimum time can damage be prevented and the increased growth recoup fumigation expenses.

Advantage was taken of the existence of varietal trials in grub-infested areas to determine the reaction of certain varieties to grub infestation, and accordingly diggings were made in order to assess the populations present. As a a result of these investigations it is apparent that the variety Q. 10 is decidedly susceptible to grub attack, and therefore it cannot be recommended in fields where this pest is likely to prove troublesome. P.O.J. 2878 was badly uprooted, but fortunately it did not deteriorate as rapidly as might have been expected. S.J. 4 maintained its superiority in withstanding attack; however, owing to the incidence of gumming disease in two of the northern mill areas, this gum-susceptible variety has already been eliminated from one mill area, and plantings in the other area will similarly have to be seriously curtailed; hence the need for a grub-resistant variety to replace S.J. 4 is a very real one. Q. 2 has exhibited considerable resistance to attack, but, until its ratooning qualities, after having suffered grub damage, can be properly assessed, its true position must still remain doubtful. In many cases it seems inevitable that for a time at least it will be necessary to revert to the variety D. 1135.

In an attempt to get rid of beetles by the destruction of their feeding trees, various tree-clearing projects have been brought forward during the year, but the only scheme of this kind in actual operation is that of the Basilisk Range, in the Mourilyan area. Judging by last year's results there appears to have been a diminution of grub infestation on the farms towards the northern end of the range, but, on the other hand, areas towards the eastern and southern end suffered more serious infestation. This brings up the question as to whether such schemes may or may not bring about a redistribution of infestation rather than a reduction. However, in view of the fact that the loci of infestation have varied so greatly in other areas in which there has been no interference with the natural flora, it seems unwise to attempt to make any pronouncement on the probable success or otherwise of this form of control until the lapse of several years; in the interim it will be of interest to watch whether the "benefited" areas remain permanently grub free or whether they again suffer infestation.

During the last beetle flighting season an attempt was made to lure beetles to certain feeding trees (*Ficus benjamini*) by the use of various chemicals, but there was no significant or marked response to any of the chemicals tested. These included the following:—Geraniol, eugenol, caproic acid, ethyl pelargonate, cinnamyl butyrate, cuminol, benzyl benzoate, safrol, w-bromo-styrene, iso-butyl-caproate, valerianic acid, cumene, methyl salicylate, benzaldehyde, iso-butyl-phenyl acetate, butyric acid, oil of bitter almonds, ammonium valerate, limonene, ethyl butyrate, butyl alcohol, isopropyl alcohol, bergamot, and mixtures of bit of sandalwood and Leptospermum citratum, eremophila and vanillin, and Huon pine and heliotropin.

As a result of opinions expressed at Conferences of Pests Boards regarding the ever-present desire to speed up fumigation work, certain experimenters have attempted to evolve an efficient horse-drawn or motor-driven unit, and, following on this work, a rather unexpected but nevertheless welcome improvement has been made in the hand injector. In this new hand injector, the fumigant is carried in a container attached to the operator's back, like a knapsack, and the injecting mechanism has been much simplified. This simplification has totally eliminated the tedious and frequent interruptions which choked injectors, and the consequent necessity for re-adjusting dosages after adjustments have been made. Tested under field conditions, the work of operating the new injector resulted in less fatigue to the operators and a conservative estimate indicates that its use would enable the operator to fumigate an additional one-third of an acre per day.

In the Mackay district, for the third successive season, this pest has been obvious in many parts of the district. Heavy losses have been experienced in a few individual cases this season, especially in parts of the St. Helens Creek flats (around Calen) and (for the first time since 1933) in the Mia Mia district. Less obvious damage occurred on a fairly wide scattered area, although, owing to the favourable autumn season, it did not become apparent until June.

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Although the method is generally condemned as uneconomic, facilities and payment for the collection of beetles were again provided by the Mackay Pest Board, and a sum of £504 9s. 2d. was absorbed in this manner. With the co-operation of the Board, however, an effort was made to further the introduction of the practice of fumigation into the district and to investigate such modifications as might be necessary to adapt it to the requirements of local conditions. Four farms were selected for trial-demonstration purposes and thorough grub surveys were made. Unfortunately inadequate facilities and organisation (as might be expected in a co-operative pioneer effort), and the unusually wet weather conditions which prevailed during March and April, militated against the complete sucess of the project. Owing to the generally late flight of beetles in the Mackay district the onset of the wet season must normally be expected to interfere with fumigation to some extent, but this year, in some instances, it was not possible to fumigate until some six or eight weeks after the grubs had concentrated under the stools.

Owing to requests from farmers the original experimental project was extended somewhat, and eventually some 141 acres were surveyed and 60·5 acres fumigated on seven farms. In some of the small patchy infestations grub counts reached as high as thirty-one per stool, while an average of nine grubs per stool was experienced throughout some fields. In the earlier period of the campaign a mixture of carbonbisulphide and paradichlorbenzene, in the proportions of two to one was injected into the soil on both sides of the stool. Towards the end of April, on some of the more difficult farms, carbonbisulphide injected on one side of the stool gave satisfactory kills. Most of the work was done with Dank's injectors; special manganese-bronze spear points were fitted for use in stony country, but the alloy proved too soft, and points had to be discarded after the fumigation of about six acres.

On farms where conditions were favourable for fumigation the full costs of fumigation amounted to approximately £6 10s. per acre, which, with the deduction of the 50 per cent. fumigant subsidy paid by the Pest Board, worked out at a domestic cost of £4 5s. per acre. On two farms with peculiar local conditions and where fumigation was done late among fallen cane, the full costs ranged from £7 10s. to £12 10s. per acre. With these two exceptions the economic results of the trial appear satisfactory, but a final pronouncement cannot be made until the check strips have been been harvested and weighed.

The preliminary work of the past two years has indicated that if fumigation is to be successfully established in the Mackay district the following four requirements must be regarded as essentials by those responsible for any fumigation campaigns:—

(1) There must be organisation and supervision of *all* phases of the work. The recent appointment of a Field Supervisor by the Pest Board is a necessary initial step in this direction.

(2) Thorough grub survey maps are a necessary pre-requisite to the initiation of a fumigation campaign.

(3) The actual fumigation must be done at the earliest opportunity after the grubs have congregated under the stools.

(4) In at least some particular localities fumigation can only be regarded as an adjunct to the growing of strong rooting varieties. In this connection it is a fortunate circumstance that the strong rooting variety P.O.J. 2878 may be grown in the areas of heaviest grub infestation. But it must be emphasised that the continued cultivation of P.O.J. 2878 is possible only in the absence of downy mildew disease; it is therefore necessary that every precaution should be taken against the introduction of this disease from areas immediately south.

The Giant Toad (*Bufo marinus* L.).

Toads were comparatively widely distributed in North Queensland cane areas by 1936, but the wet seasons of 1937 and 1938 were of short duration and the rainfall rather scanty, hence breeding was restricted to places near permanent water. However, the 1939 wet season, continuing almost without interruption for five months, provided ideal breeding conditions, and there was an extension of the breeding centres to places that are normally dry. As a consequence there was a huge increase in toad populations in areas that were previously lightly populated, and it is now considered that toads have reached peak populations in the areas where the original releases were made. Breeding has been reported from other centres where later liberations were made, and thus they continue to become established wherever colonies have been liberated.

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A problem may arise in maintaining effective populations in the high and dry red volcanic soils. These soils are devoid of much cover and they become very hot during the spring-summer months prior to beetle emergence. It is evident that in dry years it will be difficult to maintain large toad populations in these canefields during the flighting period of the beetle unless some special inducement is offered them to remain there. Moreover, since the unit grub damage to cane on these soils is particularly high, it becomes increasingly desirable to keep toad populations in these fields at a high level. It would appear that the only available method of achieving this is by a process of trash conservation which would provide suitable hide-outs and keep the soil reasonably moist. Such a scheme is worthy of a trial.

A comprehensive series of experiments for the purpose of studying any effect that toads may have on the domestic fowl were carried out during the year. The experiments were designed to test out the effect of—

(1) Possible contamination of drinking water by toads bathing in the water overnight.

(2) Contamination of the water by urinary excretions of the toads.

(3) Feeding young toads to fowls.

The tests to which the fowls were subjected were particularly severe, but no ill effects were noticeable in any way. In the feeding experiment one fowl ate no less than 142 small toads within the space of about one hour, yet it remained quite normal. These experiments are supported by the experience of some commercial poultry breeders who deny that any harm has resulted from the presence of toads in their breeding pens.

A systematic examination of the stomach contents of toads was carried out during the period December, 1938-April, 1939, to determine what constitutes the food of toads in their new habitat in North Queensland cane areas.

Unfortunately it was not possible to collect toads in the few areas where Greyback beetles were flying in appreciable numbers. and accordingly this pest was not represented in the material taken from the toads' stomachs. However, a pleasing find was 15 "frenchi" beetles (*Lepidiota frenchi* Blkb.) in the stomach of one toad, and 13 in another, whilst reports have come to hand that toads have gorged themselves on these beetles where the latter were plentiful. It was also gratifying to find that comparatively small toads (2 inches to 3 inches in length) had eaten other sugar-cane pests, namely sugar-cane borer weevils (*Rhabdocnemis obscura* Bois.), and numbers of army worms (*Spodoptera exempta* Wlk.). In the examination of the stomach contents the following orders were represented:—Blattidae, Gryllidae, Termitidae, Forficulidae, Pentatomidae, Cydnidae, Scarabaeidae, Leucanidae, Chrysomelidae, Coccinellidae, Elateridae, Carabidae, Curculoinidae, Lagriidae, Tenebrionidae, Dermestidae, Hydrophilidae, Formicidae, Mutillidae, Noctuidae, and Pyralidae. The majority of the insects belonged to the Scarabaeidae.

Beetle Borer (*Rhabdocnemis obscura* Bois.).

This pest has again operated at a lower level than in some recent years. Further observations have confirmed our expressed opinion regarding the importance of destroying all field debris which consists of discarded cane stalks or the portions of cane stalks left attached to the leaves when cutters are instructed to cut back. In far too many instances do we find complaints regarding borer infestation to be associated with a lack of field sanitation on the part of the farmer concerned or his immediate neighbours. On the other hand we continue to find evidence that where no cane stalk material is left on the field, and the cane is correctly topped, the conservation of trash is not an important factor in causing serious borer damage.

A series of experiments to test the effect of trashing cane on borer populations was carried out during the 1936-7 period, and was commented upon in the last Annual Report. A further somewhat amplified set of experimental plots was established during 1937 and harvested in the latter part of 1938. These experiments were designed to test (*a*) the effect of trashing only during the early life of the cane, (*b*) the effect of trashing only during the later life of the cane, and (*c*) the effect of keeping the cane practically trash-free throughout its entire growth period. The result of these trials showed that only the last treatment caused any appreciable reduction in borer populations; actually the population in fully-trashed plots was a little less than half that of the untrashed cane. The other

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treatments (*a*) and (*b*) caused a small reduction in borer populations but not sufficient to be of any practical value. No significant difference in tonnage was recorded from any of the treatments, nor was the C.C.S. materially affected by trashing the cane. The following table shows the figures recorded for completely-trashed plots compared with untrashed plots:—

Farm.	Treatment.	Borers per Acre.	Tons Cane per Acre.	C.C.S.
A	Trashed	15,500	30·3	16·48
A	Untrashed	19,750	28·3	16·67
B	Trashed	12,250	28·8	13·16
B	Untrashed	26,000	27·6	13·63
C	Trashed	2,250	23·0	No figures available
C	Untrashed	10,750	22·2	
D	Trashed	8,800	47·9	12·09
D	Untrashed	16,320	51·3	12·88

These experiments have served to confirm our previous view that although trashing the cane may cause a considerable reduction in borer population, since there is no appreciable increase in tonnage or C.C.S. the practice cannot be recommended as an economic means of borer control. The expense involved in the work of trashing the field is not warranted by the final result.

Only one varietal borer resistance trial was conducted during the season. This consisted of a trial of the three new varieties, Q. 13, Q. 16, and Q. 19, with Q. 2 and Badila incorporated as standards of resistance and susceptibility respectively. Top rot was severe in this plot and further evidence was given of the strong influence of this disease on the reaction of a variety towards borers. None of the three new varieties proved nearly as susceptible to borer damage as Badila. Q. 13 showed a higher borer population than its free trashing erect habit would lead one to expect, and it is believed that this was due to the high percentage of top rot which was present in this variety, for its rind is moderately hard. It should be noted that this trial was carried out on land where the incidence of both top rot and borers is far higher than normal.

Rat Pests.

During the past year rat damage in Queensland canefields has remained at a low ebb. In all Northern mill areas where organisations sponsor rat poisoning campaigns in varying and divergent forms, this type of control was again carried out and successful results are reported by those concerned.

Investigation of several phases of the rat pest problem was continued by Mr. McDougall, with the Central Sugar Experiment Station as headquarters, field work being carried out in selected portions of the Mackay district. This district has a distinct advantage from the observer's point of view in that no poisoning campaigns whatever are carried out; hence observations on fluctuations of rat populations under natural conditions cannot be influenced by such an artificial factor.

During the period January, 1938-June, 1939, the intensive population studies have been continued and monthly sample catches, totalling 2,176 specimens of *Rattus conatus*, have been carefully weighed and measured, and sub-samples dissected or stored for future reference. Such observations have now been in progress for some $2\frac{1}{2}$ years, during which time there have been experienced considerable variations in period and intensity of wet season or summer rains; spring weather conditions on the other hand have been fairly uniform and comparatively dry. Available records seem to indicate that spring is one of the critical periods determining rat populations as it covers a potential breeding maximum for the year. During the past three dry springs there has been little breeding, and at the present time rat populations are more or less confined to non-converging colonies of varying size, or to scattered nests. Within these colonies the population densities have decreased considerably —due to natural causes—over the whole period covered by our observations.

A considerable amount of time has been spent in carrying out field feeding tests, and methods of presenting poisoned food to rats. In so far as the latter is concerned no alteration to the present principle of using small scattered baits can be recommended for Queensland canefield conditions. It was found that a 10-yard grid for bait distribution was efficient; a smaller spacing seems unnecessary, while a larger distance was generally unsatisfactory.

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Continued attention has been given to the possibility of utilizing suitable cane varieties as a basis for minimising rat damage to cane. With the advent of controlled production and the possibility of standover cane becoming an integral part of the farm system, the question of varietal reaction to rat damage assumes still another aspect. Accordingly a stick count made in a rat-infested randomised variety trial recently harvested in the Innisfail area is of interest and the relevant data are set out below:—

Variety.	Total Stalks Examined.	Per Cent. Stalks Damaged.	Comparative Hardness.	Remarks.
Q. 2	2,407	0·33	18–20	Thin, free trasher.
Q. 10	2,110	11·85	4	Badly lodged, sweet cane
Q. 13	1,711	0·29	12	Fairly free trasher, sweet cane

Investigation of the possibilities of artificial protection of cane from rats has been continued, but all chemicals used as repellents have been failures. As preliminary trials of mechanical barriers small-gauge wire netting and hessian fences (2 feet 8 inches above ground) have been used to enclose small areas 30 feet by 30 feet, selected at random in localities where rats are known to be present. First observations on one of the hessian plots in a field of Co. 290 ratoons were as follows:—The fence was erected and the plot trapped out on 23rd May, 1939, *Rattus conatus* being the only species found; a stick count in this and contiguous area showed 8·5 per cent. rat-damaged stalks. On 22nd June, 1939, a count within the enclosed area showed 7·8 per cent. rat-damaged stalks, as compared with 19·5 per cent. outside the enclosure. The further results will be watched with interest; the fencing materials, although satisfactory for experimental purposes, are too expensive for more general use.

Some two years ago an unidentified Rattus species was found by us damaging cane in a restricted habitat in the Mackay district. This has led to a revision of the systematics of the Rattus group associated with canefields which was recently published by Mr. E. LeG. Troughton, of the Australian Museum, Sydney. For many years the common and widely dispersed "field rat" has been referred to as R. *culmorum*. It is now known to be *R. conatus* Thomas, whilst the more recent capture is the true *R. culmorum culmorum* T. and D. These new names fit more satisfactorily with existing records and ecological data collected during the past four years. A fact of more practical importance is that it now seems certain that two *Melomys* species of different habitats damage cane. The well-known name *M. littoralis* Lonn. is applied to a rat which, like *R. conatus*, is associated with close ground cover. On the other hand *M. cervinipes* Gould (recorded in 1938 from canefields at Sarina, Habana, and Mourilyan) is apparently a rain forest or "scrub" rat. It would appear that up to the present these species have not been separated in all Northern areas, and that, at least during years of low or moderate populations, *M. cervinipes* and sometimes another scrub rat, *R. assimilis* Gould, may be chiefly responsible for rat damage near scrub. Obviously the control of this rat cannot be associated in any way with close ground cover or harbourage.

Wireworms.

During last season infestation with the lowland wireworm (*Lacon variabilis* Cand.) was much less extensive than during 1936 and 1937. As anticipated, depressions in the better type lands were practically free of the pest. but some of the damage in the lower lands was more severe than expected. It is now thought that a late wet season, following two years of heavy infestations, might have been the cause of a moderate population survival.

In order to place wireworm studies on the more accurate foundation of population studies, a suitable power soil sifter has been installed at the Mackay Station. Up to the present, however, the populations found in well-known wireworm fields have been so small that this line of enquiry has had to be postponed until the coming spring planting. The period December-February is considered the most critical for wireworm survival. For 1938-9 this period was comparatively dry, 21·47 inches of rain being recorded at the Mackay Station. However, the heavy rains which were experienced later in the season resulted in a negligible amount of early planting in possible wireworm country so that observations on early damage have not been practicable and there has been no guide, except past history, for the selection of fields for population studies.

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New Sugar Cane Pests and Records of Parasites.

Minor sugar-cane pests hitherto unrecorded have been discovered from time to time during the past, and they have remained in the category of minor pests. However, it was rather disquieting to find that a foreign sugar-cane scale, *Aulacaspis madiunensis* Zehnt., which is of little importance in its country of origin, has become well established in the Bingera mill area of the Bundaberg district, and was causing appreciable monetary losses on a few farms. The heaviest infestations occurred on the variety P.O.J. 213, and the quality of the juice was seriously affected as a result. Other varieties carrying light infestations were Co. 290, P.O.J. 2878 and D. 1135, but as far as could be ascertained these varieties were not deleteriously affected. The scale insect is a native of Java, and, according to the nature of the recently observed outbreak, it is not a recent immigrant into Queensland. Most likely it was introduced many years ago when the system of quarantine was less rigid than at present, and it made little or no headway on the then standard varieties. Since the introduction of the new Javan varieties and the replacing by these of the old gum-susceptible varieties, the scale has found conditions favourable for its increase, and it has flourished on the variety P.O.J. 213. The standing-over of crops, has, no doubt, aided the increase of this insect. An Encyrtid parasite, *Physcus nigriclavus* Gir., was bred from this scale insect, but the total parasite complex has not yet been determined. A survey is being made of the infested area with a view to restricting its spread.

Another pest causing damage to the variety P.O.J. 213 in the Windermere area of Bundaberg was a large species of *Margarodes* (at present unnamed). Although the infestation was limited, patches of cane either died out or remained stunted. It is considered that bare fallowing during the spring-summer period when the young hatch out from eggs, will serve to eliminate this pest.

At the Bundaberg Sugar Experiment Station, the larva of a small Anthomyiid fly (*Atherigona* sp.) was found damaging the young seedling canes soon after potting out, and about 5 per cent. of the seedlings were affected. Damage consisted in killing the central heart, but the seedlings later recovered and stooled out. Apparently this infestation was an isolated case, since no further trouble occurred to warrant testing the control measures recommended.

Parasites bred from an outbreak of the army worm, *Cirphis loreyi* Dup. in the Gordonvale district included *Sturmia inconspicuella* Bar. and *Carcelia kockiana* Towns.

At Tully, the termite *Coptotermes acinaciformis* (Froggatt) was found tunnelling into mature cane, causing minor damage only, and the mould-building ant, *Aphaenogaster pythia* Forel. was causing stunting by tunnelling underneath the cane stools.

We are indebted to Mr. J. Clark, of the National Museum, Melbourne, for the identification of *Aphaenogaster pythia* Forel.; to Mr. G. F. Hill, of the Council for Scientific and Industrial Research, Canberra, for the identification of *Coptotermes acinaciformis* Froggatt; and to the Director of the Imperial Institute of Entomology for the determination of the remainder of the insects recorded here.

Gumming Disease (*B. vasculorum* (Cobb) Grieg-Smith).

The incidence of this once common disease in Southern Queensland is negligible with the now almost complete substitution of resistant varieties. It has also decreased in the Mulgrave mill area in North Queensland with the gradual elimination of S.J. 4 and H.Q. 426 and some nondescript highly susceptible varieties. With the more rigid system of varietal control available under the new Act it should be possible to eradicate this disease, or at least reduce it to negligible proportions in a short space of time.

At the time of writing an outbreak of the disease has been discovered in the Hambledon Mill area. As this outbreak is several miles removed from the Mulgrave outbreak it is obvious that diseased plants must have been brought into the area some time ago. Infection has been found on several farms extending from Woree to the Barron River, mainly in the variety S.J. 4 but also in other varieties where they adjoin diseased S.J. 4.

Resistance trials were carried out in three centres, mainly with the object of testing the resistance of Q. seedlings or unnamed seedlings still under test. The Bundaberg trial consisted of unnamed seedlings and standards; with one doubtful exception all seedings tested were satisfactorily resistant.

In a trial conducted in the Mulgrave area, where the variety D. 1135 is accepted as the approximate standard of minimum resistance, S.J. 4, H.Q. 426, Q. 19 and Q. 26 were found to be definitely inferior to D. 1135; Q. 2, Q. 10, Q. 16 and Q. 27 appeared to be of equal or somewhat superior resistance, while Q. 13 and Q. 29 appeared markedly superior. Progress

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results from a trial being conducted in the pathology plot in Brisbane are as follows:—S.J. 4, Q. 19 and H.Q. 426 are showing less resistance than D. 1135 and 1900 Seedlings, while Q. 10, Q. 13, Q. 20, Q. 21 and 31–1389 have shown greater resistance, it being of the order of that shown by Q. 813 The variety 31–1389 (P.O.J. 2878 × 26.C. 270) was imported last year from Hawaii, where it is regarded as highly promising.

No further work was done on the question of alternate hosts of gumming disease, but results have been summarised and published as Technical Communication No. 3 (1939): "Alternate Hosts of *B. Vasculorum*, The Causal Agent of Gumming Disease," by C. G. Hughes.

Fiji Disease.

In last year's Annual Report we recorded the finding of a serious outbreak of Fiji disease in the Bundaberg district, and the total of infected properties as at 30th June, 1938, was 38; the disease had actually been found on 49 farms and plantations of three companies—or five individual plantations—during the year. As recorded in that report the Bundaberg District Executive had constituted itself a provisional Disease Control Board and had supplied an inspectional and roguing gang to co-operate with field officers of this Bureau in reducing the incidence of the disease. This provisional board has since been succeeded by the legislatively constituted Bundaberg Cane Disease Control Board, which is now employing three inspectors, each assisted by a gang of two to four men. As a result of the eradication orders issued by the Bureau last year and the inspections and roguing carried out by the inspectional gangs there has been a very rapid and distinct improvement in the Fiji disease situation. The serious outbreak in the Woongarra has been virtually cleaned up, while, taking the district as a whole, the situation is generally satisfactory. Although the thorough district-wide inspections have revealed a number of new centres of infection these have been adequately dealt with, and, with the exception of a few fields which will be ploughed out this year, infection is restricted to a few diseased stools per farm. The general position is summarised below:—

Mill Area.	Diseased during 1937-38.	Diseased as at 30th June, 1939.	New Records 1938-39.	Diseased 1938 but now Healthy.
Bingera	12	30	21	3
Fairymead	4	10	9	3
Millaquin	19	41	30	8
Qunaba	14	17	11	8
Total	49	98	71	22

The improvement in the position may be gauged from the fact that whereas last spring it was found necessary to issue 50 disease eradication orders in respect of Fiji disease, during the coming spring, in spite of very much more extensive surveys having been carried out, it is not expected that half this number of orders will be issued.

In the Isis Mill district the position has continued to improve and the Disease Control Board has considered the position warranted the reduction of the inspectional staff to one inspector. No cases of more than a few stools per farm have been noted. The position in the Moreton District appears to have improved slightly; a number of badly diseased fields were destroyed early in the year and possibly a further 50 disease eradication orders will be issued during the coming spring. This action, together with the appointment of a seasonal inspector and assistants by the Disease Control Board, will doubtless bring about an improvement in the 1940 crop. The Maryborough Board has appointed an inspector with assistants who will first of all concentrate on the outer less heavily infested areas; for the present the growth of susceptible varieties is prohibited in the areas of heavier infestation.

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Varietal resistance trials are perforce conducted in the south-eastern portion of the State, where serious droughts were experienced last year and consequently spread of Fiji disease in the resistance trials was not as rapid as usual; results are not obtainable until the first ratoon crop but in the case of the current first ratoon crop, this will have to be taken to second ratoons for final results. Progress inspections indicate no infection in Jason, Co. 290, C.P. 29/116, P.O.J. 213, Q. 813 and Erianthus; Q. 23 appears resistant, but Q. 25 falls into the general class of D. 1135, Comus and P.O.J. 2878. Co. 419, a cross between P.O.J. 2878 and Co. 290, has exhibited very high susceptibility while, on the other hand, Erianthus has not only developed no disease but no leaf hoppers have been observed on it at any time.

Although apparently in the P.O.J. 2878 class for Fiji susceptibility the variety Q. 25 is being set out in farm trials in the Bundaberg District. It is considered that with the present disease control organisation Fiji disease can be readily controlled, at least in unirrigated sections, in varieties of the order of susceptibility of P.O.J. 2878; consequently the high downy mildew resistance of Q. 25 makes further trial of this variety highly desirable.

The current plant resistance trial consists mainly of standards and unnamed seedlings, together with the reputed cane-sorghum crosses Co. 352, Co. 355 and Co. 356. The high vigour and generally satisfactory characteristics of the cross P.O.J. 2878 × Co. 290 makes this a desirable cross for Southern Queensland conditions, and, to get an insight into the general Fiji resistance of the progeny of this cross, it is proposed to include 100 seedlings in the trial to be planted during the spring.

It is of interest to record that 16 stools of Fiji disease were found in a field of Co. 290 in the Maryborough district, the source of infection being traced back to a single stool in the ratoons of the crop from which plants were taken. Previously there has been a record of the occurrence of Fiji disease in only a single stool of primary infection in Co. 290, and there was then some possibility that the stool may have been a supply plant of another variety.

Chlorotic Streak.

The causal agency of this disease remains unknown, but it has been impossible to devote much time to its study on account of pressure of more obvious practical problems. Further inoculation tests have been carried out, using plant extracts from leaves, buds and stalks, but with no positive results to date.

Hot water treatment has been further tested for varying periods of time and at varying temperatures; after 2-3 minutes preheating exposure of setts to a temperature of 42·5 deg. C. for 20 minutes failed to reduce the amount of disease, but no disease developed in setts so treated at 45 deg. C. A further trial of some interest was the treatment of single buds at 52 deg. C. for 20 minutes; the base of a glass tube of 2 cm. diameter was cemented around the buds with grafting wax and water at 52 deg. C. flowed continuously over the bud. Alternate buds were treated and the remainder planted as controls. A total of 18 untreated buds produced 9 definitely diseased stools and 1 doubtful, while a similar number of treated buds gave 3 diseased stools and 1 doubtful. The test will be repeated in order to determine whether the difference is significant. This trial was undertaken after temperature determinations *in situ* had indicated that when cane of that particular thickness was immersed in water at 52 deg. C. it took 35-40 minutes for the temperature in the centre of the sett to reach 35 deg. C. and 45 minutes to reach 52 deg. C.

A number of observations in the field and in trials suggest that there is recovery from this disease, and not all buds of diseased stalks necessarily give rise to the disease.

Hot water treated setts of S.J. 4 planted in a bad chlorotic streak area in Babinda during May, June, July, August, and September, and all ratooned during August, 1938, showed important differences in the number of diseased stools which appeared after ratooning. The later planted plots showed far more diseased stools than those planted earlier, and there was a steady increase in the number of diseased stools from the May plantings onwards.

Serial nodal plantings of healthy and chlorotic streak diseased sticks from the same stool were made during 1938 to try to determine the course of the progress of the disease in the sticks. Most of the setts from sticks which had showed symptoms also produced

Report of the Division of Entomology and Pathology—continued.

diseased shoots on germination, but very few of the setts from sticks which showed no symptoms, when selected for planting, developed diseased shoots. In neither case was there any indication of the progress of the disease up or down the stick. Unfortunately, the dry conditions which were experienced during the latter half of last year rather interfered with the growth of the plot.

Plantings of diseased and healthy cane at an elevation of about 2,000 feet were made in 1937 on the Atherton Tableland, at a point far removed from any cane. Stools bearing symptoms have been observed at all times, but there has been no spread of the disease to the plants from originally healthy setts.

Two chlorotic streak varietal resistance trials, which were planted during 1937 and harvested during the spring of 1938, yielded in the ratoons valuable information concerning the relative susceptibility of a number of varieties. In addition to new Q. seedlings and several standard varieties, a number of varieties which are used as breeding parents were included in the trial. The following details showed the ratio of diseased stools to the total number of stools:—

Variety.	Farm A.		Farm B.	
	Ratio Diseased : Healthy Stools.	Ratio as Approximate Per Cent.	Ratio Diseased : Healthy Stools.	Ratio as Approximate Per Cent.
S.J. 4	73/75	97	62/91	68
H.Q. 426	..	..	41/79	52
Juno	16/17	94	5/34	15
Badila	69/74	93	27/74	37
P.O.J. 2878	58/66	87	30/82	37
Q. 19	56/66	85	30/60	50
H.Q. 409	68/81	84	..	..
Oramboo	35/42	83	7/48	15
Pompey	66/81	81	..	..
P.O.J. 2725	47/59	80	..	..
Hector	33/43	77	28/92	30
Korpi	30/43	70	8/78	10
E.K. 28	21/33	63	..	..
Q. 16	27/46	59	9/51	18
Q. 13	30/51	59	19/81	23
Q. 10	34/67	51	16/62	26
"X" 7 (Badila × S.C. 12/4)	24/50	48	..	..
P.O.J. 2940	28/59	47	..	..
Q. 12	..	..	11/68	16
S.W. 499	8/25	32	..	..
Brutus	..	..	8/55	15
Q. 2	15/48	31	4/49	8
B. 147	17/72	24	..	..
P.O.J. 100	14/60	23	..	..
P.O.J. 2364	7/55	13	1/62	2
Q. 813	6/63	9	..	..
"X" 1 (Blk. Cheribon x S. Robustum)	3/72	4	3/73	4
"X" 14 (Blk. Cheribon x S. Robustum)	2/66	3	1/75	1
P.O.J. 213	2/70	3	1/55	2
Co. 290	1/35	3	*1/77	*1
Vulcan	1/73	1	..	..
Uba	0/71	0	3/84	4
P.O.J. 234	0/70	0	*1/33	*3
Q. 4	0/55	0	..	..

* Signifies a doubtful case.

It will be seen that with the exception of Juno (of which there were only 17 stools germinated on Farm A) there is a more or less general agreement between the two trials with greatest resistance associated with the derivations of the robustum or chunnee lines.

Leaf-scald (*Bacterium albilineans* Ashby).

Leaf-scald was not much in evidence during the period under review, and the only investigational work was the conduct of a resistance trial. This trial was planted in the wet area between Gordonvale and Babinda on soil which was naturally badly drained, but which carried surface drains. As usual, setts were inoculated in the freshly cut ends prior to planting, a mixture of culture suspension and juice from several varieties of diseased cane being used. Where supplies permitted, 50 setts were inoculated, while a similar number of non-inoculated setts were planted.

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A notable result in this trial was the appreciable amount of natural secondary spread of the disease which took place, an occurrence which was unusual in trials conducted in dryer areas. Results from the trial were as set out below—

Variety.	Per Cent. Diseased Stools from—		Remarks.	
	Inoculated Setts.	Non-inoculated Setts.		
30 R. 61	75+	45	Arrowed	C
Q. 26	75+	4		E
28 N.G. 52	50–75	0		M
H.Q. 426	50–75	6		E
28 N.G. 269	50–75	4		E
Q. 21	50–75	0	Arrowed	C
Juno	30–50	8	Arrowed	C
S.J. 4	30–50	0		M
28 N.G. 22	30–50	0	Arrowed	M
18 R. 1163	30–50	0	Arrowed	C
Q. 19	30–50	0		M
24 R. 2771	20–30	0	Arrowed	C
Nestor	20–30	30	Arrowed	L
18 R. 1406	20–30	0		C
Q. 13	20–30	0		L
Badila	20–30	0		C
28 S.N.F. 42	10–20	0		
Brutus	10–20	0		
Q. 27	10–20	0	Arrowed	
28 M.Q. 734	10–20	0		
Oramboo	10–20	0		
24 R. 2074	0–10	0		
Co. 270	0	0	Arrowed	
Co. 421	0	0	Arrowed	
24 R. 1057	0	*15		
25 R. 96	0	0	Arrowed	
25 R. 408	0	0		
25 R. 491	0	0		
30 M.Q. 2124	0	0	Arrowed	
Vulcan	0	0		
Q. 2	0	0	Arrowed	
Q. 10	0	0	Arrowed	
Q. 1098	0	0	Arrowed	
P.O.J. 2878	0	3	Arrowed	

NOTES :—

1. *Only 13, out of 25 setts planted, germinated and of these two stools became diseased.

2. Time of appearance of infection is recorded for all varieties with more than 20 per cent. infection; C indicates that new infection appeared more or less continuously; E, the bulk of infection became evident early; M, mid-season; and L, late season.

3. It should be noted that in the case of Nestor and 30 R. 61 the late infection showed up only in side shoots which developed after arrowing.

In evaluating this trial by reference to the standard variety H.Q. 426 it would appear that for North Queensland wet area conditions the varieties 30 R.61 and Q.26 are too susceptible, while varieties from 28 N.G.52 to Q. 19, inclusive, should not be taken further unless they have otherwise definitely outstanding qualities. The dryer the conditions, of course, the more the minimum required standard of resistance can be lowered.

Downy Mildew.

Downy mildew at present constitutes the chief sugar-cane disease problem in this State, and is, to a considerable extent, a limiting factor in the control of other diseases. The reasons for this are: (*a*) the disease is present, and has been present for many years, in nearly all cane areas; and (*b*) the Kassoer and Chunnee breeding lines show high susceptibility.

The present situation is that small scattered centres of infection are known in the Mossman, Hambledon, and Mulgrave areas; no infection has been reported from Babinda, Johnstone, and Tully, but a small outbreak was found at Ingham in 1938. In the Lower Burdekin and Mackay districts the situation has been somewhat improved by the gradual elimination of B. 208 and P.O.J. 2878. Since crops of other standard varieties growing in the vicinity of diseased P.O.J. 2878 were found to be diseased, it was obviously an urgent requirement that the cane in these fields be destroyed, and some 47 disease eradication orders, covering 279 acres, were issued during the period under review. The varieties covered by these orders were mainly P.O.J. 2878, and to a less extent, P.O.J. 213. The area involved was mainly the better class land lying on either side of the Pioneer River. A further batch of orders will be issued during the coming spring.

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In the Bundaberg district the disease has spread in a disconcerting manner in the past two years, owing to the high susceptibility and predominance of the two varieties P.O.J. 2878 and P.O.J. 213, and the fact that in both the 1938 and 1939 seasons warm, moist conditions have continued unusually late into autumn, thus increasing the time and rate of spread. Relatively small centres of infection have been found in the South Kalkie, South Bingera, and Pine Creek sections, but the chief centre is the wellknown Woongarra, where the disease is "peppered" throughout the farms of the area. Although fields of heavy infection are few the widespread nature of the infection, coupled with the large proportion of the crop which will be stood over under the present cropping policy, makes the position serious. Fortunately, with the passage of the 1938 Amendment Act, it has been possible to create a Disease Control Board for Bundaberg, and this body is tackling its job with energy and determination. Given normal weather conditions, and the ability to harvest projected quotas, the work of the roguing gangs employed by this Board should result in a big improvement by 1940.

Fortunately, no sign of the disease has yet been observed in the areas of Isis, and south.

Routine resistance trials were established in the Bundaberg and Mackay districts, and results are set out below. Unnamed selected seedlings are included in each class in brackets; the key number in each case refers to the particular station, the E series of Bundaberg not being identical with the E series of Mackay.

Percentage Infection Class.	Bundaberg.	Mackay.
Nil	Q. 25, C.P. 29/116 (E. 12)	Comus (F. 40)
0–10	Comus, Jason (E. 3)	(F. 21, G. 39, G. 52)
10–20	(E. 16, E. 18)	S.J. 4, Q. 20, H.Q. 426, (F. 58, G. 58)
20–30	Q. 23, Q. 813, Co. 290 (E. 6)	Q. 813, Q. 28, Co. 290, (G. 22, G. 19)
30–50	S.C. 12/4, P.O.J. 234, P.O.J. 2875, P.O.J. 2883 (E. 14)	P.O.J. 2725, 1900 S., S.J. 16 (G. 8, E. 45, G. 18, F. 57, G. 17, G. 20, E. 4, F. 31)
50–75	Q. 2, P.O.J. 2725, Q. 22, P.O.J. 2878 (E. 15, C. 12)	P.O.J. 213 (G. 5)
Over 75	P.O.J. 213, P.O.J. 2940, Q. 24, Co. 419 (E. 10)	P.O.J. 2878

NOTE.—Varieties in the above classes are given in descending order of observed resistance, thus in the Mackay trial, for example, S.J. 16 exhibited very little greater resistance than P.O.J. 213.

It will be seen that the general order of resistance of standard varieties is similar in both trials, and it will be seen that, in comparison with the resistance of well-known standards, a number of the seedlings possess a satisfactory standard of resistance. This particularly applies to the seedling Q. 25, which was bred on the Bundaberg Station. This is a seedling of considerable promise, and its very high resistance to downy mildew is very gratifying; as stated elsewhere, it has exhibited definite susceptibility to Fiji disease, but in spite of this it is considered that if it continues to live up to promise its downy mildew resistance should make it a very valuable cane in certain areas.

An apparent anomaly exists in the case of P.O.J. 2725 in the Bundaberg trial in that it appears much more susceptible than previous trials had led us to expect. Early in the course of the trial some stock had gained entry to the trial and had eaten the tops of a considerable number of stools. It was noted that infection was heavier in that half of the trial where damage mainly occurred; this half contained in general one of the two plots of each variety, but it was noted that both plots of P.O.J. 2725 had been eaten. A stool plan of the trial was then set out and the condition of each stool with reference to damage and disease was recorded. From an analysis of these data, it would appear that the damaged stools were twice as likely to become diseased as undamaged stools. Whether this is due to the check in growth, or rendering immature buds more easy of access to spores, is not known. In the face of this finding, however, the above rating of P.O.J. 2725, E. 6, E. 14, and E. 18 in the Bundaberg trial is a probable understatement of the resistance of these four varieties, which were all extensively damaged in the early stages of the trial.

Field observations over the past two years have strongly suggested the possibility that maize grown in the vicinity of canefields has been responsible for the spread of outbreaks of downy mildew, if not for their initiation. In some consequent studies on alternative hosts

and sporulation, made by Mr. Leece, some interesting data have been obtained. In an alternate host trial the following plants were interplanted with downy mildew diseased sugar-cane of the varieties P.O.J. 2878 and P.O.J. 213:—

(*a*) *Zea mays* L.: 3 varieties—Imperial Yellow Dent, Funk's 90-Day, and Reid's Yellow Dent.

(*b*) *Sorghum* spp. Snow.: 3 varieties—Natal 6, Wheatland Milo, and American Early Red.

(*c*) *Panicum maximum* Jacq.: var. coloratum.

(*d*) *Panicum maximum* Jacq.: Guinea grass.

(*e*) *Brachiaria mutica* (Forsk) Stapf.: Para grass.

(*f*) *Echinochloa Crus-galli* Beauv.: Japanese Millet.

(*g*) *Sorghum halepense* (L.) Pers.: Johnson grass.

(*h*) *Sorghum sudanense* Stapf.: Soudan grass.

(*i*) *Pennesetum purpureum* Schum.: Elephant grass.

(*j*) *Pennesetum glaucum* R.Br.: Pearl millet.

The results of this trial were that all hills of the three varieties of corn rapidly became heavily infected and produced spores in quantity from both surfaces of leaves. Leaf streaks were readily visible on all sorghums, but no visible downy mildew was produced; on only one occasion were a few spores scraped from the leaves of Natal 6, but nothing from the other varieties. A few odd leaf streaks and a few spores and sporophores were observed on Johnson grass on one occasion, a few leaf streaks but no spores on Soudan grass, and no symptoms or spores on the remainder. Sugar-cane was reinfected by the exposure of freshly-cut setts of the variety P.O.J. 213 beneath the leaves of diseased maize.

The results of this trial and current field observations have indicated that maize is readily infected with sugar-cane downy mildew, that infection sweeps through the maize in the course of a very few weeks, and that the disease produces a marked stunting and malformation of plant and cobs. The ultimate course of the fungus in the maize plant has not yet been determined, but it is obvious that planting of corn in the vicinity of sugar-cane, in the presence of downy mildew, must be condemned.

Observations on sporulation, made on excised cane leaves exposed in a multiple temperature incubator at approximately 2 degree intervals, indicate that the minimum temperature for sporulation is about 16 deg. C. and the maximum about 31 deg. C.; heavy sporulation occurred between 21 deg. C. and 28·5 deg. C., with no defined optimum. The question of exposure to changing temperatures is receiving further attention. Spore production took place about the same period after exposure to darkness, but appeared to require some exposure to sunlight each day. The greatest spore production was obtained from freshly opened leaves and was heaviest near the tops of these leaves. Germination of spores took place freely in water. A considerable amount of study of the histology of the disease in cane and corn has been undertaken.

Miscellaneous Diseases.

Rind disease (*Pleocyta sacchari* (Mass.) Petr. and Syd.) was again in evidence in fields of S.J. 4 in North Queensland during the dry spring conditions of 1938, but losses were considerably less than the previous year. Inoculations with commonly associated fungi plus *P. sacchari* failed to give appreciable variation in symptoms or rate of penetration.

A root disease trial was carried out under non-irrigated conditions at Bundaberg, using the varieties Q. 813 and P.O.J. 2878 inoculated with *Pythium* sp., *Pythium* sp. plus molasses, *Pythium* sp. plus superphosphate, *Marasmius sacchari* Wakker, *Fusarium* sp., and *Rhizoctonia* sp. Under these conditions *Pythium* and *Rhizoctonia* had no visible effect, but *Marasmius sacchari* definitely stunted Q. 813, and the *Fusarium* appeared to stunt both varieties. In a second irrigated trial conducted in the pathology plot stunting of Q. 813 was caused by *Marasmius sacchari* and *Pythium* plus molasses.

Report of the Division of Entomology and Pathology—continued.

Cultures of Nitrogen Fixing Bacteria.

In spring, 1938, cultures of nitrogen fixing bacteria for standard green manure crops were made available to canegrowers at a nominal charge. This service was very favourably received and cultures were purchased for the inoculation of seed sufficient to plant nearly 2.000 acres of the cowpea group. Cultures were also provided for the inoculation of small parcels of soybeans and lucerne.

Laboratory investigation showed that the cultures as made up for sale attained maximum numbers of bacteria about four weeks after subculturing, but counts showed a rapid decline after a further two weeks. Cultures were still viable three months but not six months after subculturing.

Introduction of Varieties.

Actually no varieties were introduced from abroad during the period under review, the 1938 importations having been received just prior to the writing of the last report, and the 1939 importations being not yet to hand; the latter comprise six varieties from Hawaii and two from the United States.

The following varieties were introduced from New South Wales, New Guinea, and Fiji through the courtesy of the Colonial Sugar Refining Company Ltd.:—30 S.N.225, 30 S.N.362, 30 S.N.451, 30 S.N.673, 30 S.N.874, 30 S.N.1031, 33 S.N.1160, 30 G.1250, 30 G.1759, Marcus, 30 R.115, and 37 N.G.6. The lastnamed variety was collected in New Guinea by Messrs. Pemberton and Lennox, of the Experiment Station of the Hawaiian Sugar Planters' Association.

Division of Mill Technology

E. R. Behne, Chief Assistant Mill Technologist.

Staff.

For the first six months of this year Mr. L. C. Home was appointed Temporary Laboratory Assistant, whilst the classification of Mr. E. R. Behne was raised to that of Chief Assistant Mill Technologist. Apart from these, no changes occurred in the staff of the Technology Division.

Mutual Control.

The Seventh Annual Synopsis of Mill Data for Mills in the Mutual Control, giving the figures for the 1938 season, has been published. Again twenty-four mills were incorporated in the scheme. The calculation sheets for the 1939 scheme have been revised and issued. Several new items were included.

In conjunction with the Queensland Branch of the Standards Association of Australia, a tentative definition of "Heating Surface," as applied to calandrias and coils in evaporators and pans, was submited to the headquarters of the Standards Association. In the meantime this definition has been forwarded to all mills for use in connection with values reported in the Mutual Control.

Standardisation of Apparatus.

The following is a record of the standardisation work carried out during the year; this work forming an important part of the interseason activities:—

Brix Spindles.—Of 291 spindles tested, 219 conformed to official requirements. Of the remaining seventy-two, which received unofficial certificates, fourteen were of unofficial range, and the remaining fifty-eight were beyond the limits of tolerance allowed. None of the spindles of unofficial range had errors beyond the set limits of tolerance.

Polariscope Tubes.—Twelve were tested, and all were satisfactory.

Polariscopes.—Two instruments were checked and adjusted.

Pipettes.—Of seventy-three pipettes tested, twenty-eight were rejected.

Burettes.—Two were tested and found satisfactory.

Cylinders.—Nine were tested and found satisfactory.

Flasks.—One hundred and eighty-one were tested, and forty-one of these were condemned.

Thermometers.—Four were tested, all being satisfactory.

Quartz Plates.—One was tested and found satisfactory.

Weights.—Of three sets tested, corrections were supplied for two sets, the other set being beyond tolerance.

In all 578 pieces of apparatus were tested, compared with 454 for the previous year.

Colorimetric Standard pH Sets.

As in previous years, standard phenol red colour tubes and standard indicator solution were prepared and forwarded to the mills.

Sugar Bureau pH Meters.

During visits to mills, the opportunity was taken to examine Sugar Bureau pH meters, and in many cases slight faults were corrected. At the end of the 1938 season several meters were returned to the makers for adjustment or conversion to the latest circuit. These meters were then recalibrated and checked at the Bureau.

Investigations in connection with the development of the automatic pH controller were continued and suitable gear obtained for further testing during the 1939 season.

Another direction in which the pH meter circuit appears to have a valuable application is in connection with electrical conductivity determinations. Preliminary tests have shown that the accuracy obtained with the pH meter as the null point indicator in conductivity measurements is considerably greater than with earphones.

Division of Mill Technology—continued.

Slack Season Research by Mill Officers.

Mr. J. Heron, employed during the crushing season by the Babinda Central Mill, collaborated with Mr. A. H. Praeger, of the Bureau Staff, in an investigation of the physical properties of final molasses. The results of this work will appear as a Technical Communication which will be published shortly.

Technical Papers.

Four papers were presented by the Technology Staff of the Bureau at the Tenth Annual Conference of the Queensland Society of Sugar Cane Technologists. These were as follows:—

Behne, E. R., "Developments in Sugar Boiling."
Jenkins, G. H., "Rotary Filters in Queensland Mills."
Praeger, A. H., "Notes on Boiler Feed Water Treatment."
Clayton, J. L., "Air Preheaters."

Technical Communications.

In the current year the following Technical Communications were prepared and published by this Division:—

1938.—Technical Communication No. 4—"Milling Tests, 1937 Season," by G. H. Jenkins.
Technical Communication No. 5—"The Analysis and Sampling of Final Bagasse," by G. H. Jenkins.
Technical Communication No. 6—"Clarification Tests, 1937 Season," by E. R. Behne and G. H. Jenkins.
Technical Communication No. 7—"Volume and Surface Relationships of Raw Sugar," by L. Drinnen.
Technical Communication No. 8—"The Separation of Molasses from the Sugar Crystals in the Fugals," by E. H. Behne.

1939.—Technical Communication No. 1—"Clarification Tests, 1938 season," by E. R. Behne.
Technical Communication No. 2—"Automatic Liming Control," by E. R. Behne.
Technical Communication No. 4—"The Fugalling Process and High Speed Centrifugals," by E. R. Behne.

Exhibit Evening.

On 15th June a demonstration of apparatus, together with illustrations of the principles underlying important items of factory control, was provided for members of the Brisbane Branch of the Australian Chemical Institute.

Seasonal Investigations, 1939.

The third annual meeting of the Mill Research Programme Committee was held on 23rd March, 1939, during the Conference of the Queensland Society of Sugar Cane Technologists at Ayr. The new Chairman, elected to succeed Mr. V. Thorp, was Mr. S. V. Fevre, of Farleigh. Mr. J. S. Pollard was elected Secretary.

The programme of investigation for the 1939 season adopted at this meeting is as follows:—

1. Boiler Tests on Boiler Economiser Unit at Bingera.
2. Clarification—
   (*a*) Further development of automatic liming control.
   (*b*) Application of fractional liming in the Northern district.
   (*c*) Tests on Rotary Filters.
   (*d*) Tests on Dorr Clarifier.
   (*e*) Investigations of Cold Digestion Liming.
3. Investigation of application of crystallizers to high-grade massecuites.
4. Investigation of influence of degree of preparation on milling results.
5. Mill visits.
6. Incidental work, &c.

Division of Mill Technology—continued.

Mill Work, 1938 Season.

As was anticipated in the Director's estimate in the last Annual Report, the quantity of cane crushed during the 1938 season constituted a record. The Southern and Central districts, with excellent seasons, contributed largely to the total, and more than compensated for low tonnages in several of the Northern mills, where early in the season comparatively dry conditions prevailed.

—	Season.	Pol in Cane.	Fibre in Cane.	Purity, 1st Expd. Juice.
		Per cent.	Per cent.	Per cent.
Southern District	1930	14·58	15·00	89·91
	1931	15·01	15·40	88·25
	1932	13·32	15·16	84·95
	1933	13·55	15·21	87·65
	1934	14·67	14·59	89·74
	1935	14·56	14·47	88·60
	1936	15·31	14·32	88·83
	1937	15·05	14·04	88·14
	1938	14·62	13·66	88·87
Central District	1930	16·80	13·06	91·70
	1931	16·73	12·42	89·93
	1932	16·22	11·99	90·02
	1933	15·40	12·25	90·84
	1934	16·45	12·20	90·82
	1935	16·54	12·36	90·78
	1936	16·43	11·84	90·91
	1937	16·62	10·96	90·06
	1938	16·70	11·55	91·58
Northern District	1930	15·98	11·38	90·77
	1931	15·56	10·61	89·94
	1932	16·01	10·51	90·11
	1933	14·92	10·27	88·84
	1934	15·16	10·30	89·08
	1935	15·91	11·35	89·63
	1936	15·01	9·92	87·92
	1937	16·14	10·12	89·79
	1938	15·74	10·17	89·95
All Districts	1930	15·97	12·59	90·90
	1931	15·94	12·28	89·59
	1932	15·90	11·51	89·64
	1933	14·85	12·00	89·40
	1934	15·57	12·23	89·95
	1935	15·84	12·39	89·83
	1936	15·66	11·63	89·36
	1937	16·15	11·17	89·61
	1938	15·84	11·63	90·32

The average quality of the cane was good, the quantity required to produce one ton of 94 net titre sugar (6·87 tons) being the third lowest on record. This resulted in a record output of raw sugar.

TONS OF CANE PER TON OF 94 N.T. SUGAR.

1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	1938.
7·18	6·91	6·83	6·64	6·90	7·31	6·97	6·92	6·94	6·73	6·87

Crushing rates again increased, particularly in the Southern and Central districts, without any loss of milling efficiency, as indicated by the value for lost cane juice per cent. fibre. The pol extraction, however, was slightly lower than in the previous year.

AVERAGE CRUSHING RATES (TONS CANE PER HOUR).

1933.	1934.	1935.	1936.	1937.	1938.
45·88	48·92	50·80	54·83	55·73	60·80

Division of Mill Technology—continued.

The co-efficient of work was somewhat less than that of the two previous years, whilst pol recovery (both overall and on mixed juice) was the lowest for several years. Similar remarks apply to boiling-house efficiency, which has shown a downward trend for the past three seasons.

SOUTHERN DISTRICT.

—	1932.	1933.	1934.	1935.	1936.	1937.	1938.
Tons of cane	208,591	659,393	817,551	909,223	794,390	647,220	1,035,992
Tons of 94 n.t. sugar	23,747	77,229	107,676	117,467	109,142	85,131	135,261
Tons of cane per ton 94 n.t. sugar	8·784	8·538	7·593	7·74	7·28	7·60	7·66
Pol in cane	13·32	13·55	14·67	14·56	15·31	15·05	14·62
Fibre in cane	15·16	15·21	14·59	14·47	14·32	14·04	13·66
Purity—							
First expressed juice	84·95	87·65	89·74	88·6	88·83	88·14	88·87
Clarified juice	83·87	86·88	88·44	87·78	87·57	87·23	88·07
Syrup	83·59	87·38	88·73	88·1	87·97	87·42	88·33
Gallons molasses per ton cane	5·97	4·95	4·02	4·11	4·36	4·91	4·13
Apparent purity final molasses	39·06	40·96	41·24	39·72	40·07	41·23	39·05
Overall recovery	81·62	83·63	85·70	86·08	85·98	83·83	85·46
Recovery on mixed juice	87·42	89·74	89·59	91·995	90·64	87·81	89·82
Boiling house efficiency	94·09	95·11	96·12	96·94	95·41	92·82	94·55

CENTRAL DISTRICT.

—	1932.	1933.	1934.	1935.	1936.	1937.	1938.
Tons of cane	1,283,821	1,737,205	1,766,564	1,530,240	1,966,183	1,961,413	2,030,166
Tons of 94 n.t. sugar	190,995	249,680	271,437	233,901	301,893	304,502	314,574
Tons of cane per ton 94 n.t. sugar	6·722	6·958	6·508	6·542	6·51	6·44	6·45
Pol in cane	16·22	15·40	16·45	16·54	16·43	16·62	16·70
Fibre in cane	11·99	12·25	12·20	12·36	11·84	10·96	11·55
Purity –							
First expressed juice	90·02	90·84	90·82	90·78	90·91	90·06	91·58
Clarified juice	89·38	90·47	90·42	90·01	90·25	89·55	90·77
Syrup	89·52	90·52	90·41	90·06	90·54	89·84	91·04
Gallons molasses per ton cane	4·60	4·08	3·60	3·91	3·71	4·13	3·72
Apparent purity final molasses	39·50	40·28	38·91	39·52	37·22	35·93	37·85
Overall recovery	86·56	87·44	88·69	88·79	88·62	89·00	88·72
Recovery on mixed juice	91·77	92·38	93·53	93·79	93·20	93·25	92·70
Boiling house efficiency	96·02	96·26	97·47	97·8	97·08	97·54	96·26

NORTHERN DISTRICT.

—	1932.	1933.	1934.	1935.	1936.	1937.	1938.
Tons of cane	2,054,031	2,270,430	1,685,876	1,780,804	2,410,638	2,524,301	2,275,927
Tons of 94 n.t. sugar	299,343	311,825	233,457	258,958	333,613	373,692	328,301
Tons of cane per ton 94 n.t. sugar	6·862	7·281	7·221	6·877	7·23	6·76	6·93
Pol in cane	16·07	14·92	15·16	15·91	15·01	16·14	15·74
Fibre in cane	10·51	10·27	10·30	11·35	9·92	10·12	10·17
Purity—							
First expressed juice	90·11	88·84	89·08	89·63	87·92	89·79	89·95
Clarified juice	89·63	89·19	89·68	89·96	88·59	90·29	90·07
Syrup	90·30	89·23	89·64	89·89	88·58	89·85	90·89
Gallons molasses per ton cane	3·63	3·65	3·79	3·86	3·94	3·51	3·39
Apparent purity final molasses	37·33	35·21	37·78	36·53	31·66	34·62	34·38
Overall recovery	87·85	87·94	86·80	87·93	88·10	88·01	87·50
Recovery on mixed juice	92·43	92·71	91·62	92·86	92·58	92·44	92·53
Boiling house efficiency	96·67	97·60	96·34	97·34	97·97	96·80	96·89

Division of Mill Technology—continued.

ALL QUEENSLAND DISTRICTS.

——	1932.	1933.	1934.	1935.	1936.	1937.	1938.
Tons of cane	3,546,443	4,667,028	4,269,991	4,220,267	5,171,211	5,132,934	5,342,085
Tons of 94 n.t. sugar	514,085	638,734	612,570	610,326	744,648	763,325	778,136
Tons of cane per ton 94 n.t. sugar	6·885	7·307	6·970	6·915	6·94	6·73	6·87
Pol in cane	15·90	14·85	15·57	15·84	15·66	16·15	15·84
Fibre in cane	11·51	12·00	12·23	12·39	11·63	11·17	11·63
Purity—							
First expressed juice ..	89·64	89·40	89·95	89·83	89·36	89·61	90·32
Clarified juice	89·15	89·25	89·42	89·51	89·07	89·44	89·83
Syrup	89·42	89·41	89·48	89·57	89·27	89·41	90·29
Gallons molasses per ton cane ..	4·18	4·07	3·76	3·93	3·96	4·02	3·54
Apparent purity final molasses ..	38·31	38·55	39·20	38·33	35·54	36·62	37·08
Overall recovery	86·88	86·76	87·37	87·8	87·90	87·79	87·52
Recovery on mixed juice ..	91·86	91·88	92·49	92·98	92·52	92·20	92·01
Boiling house efficiency ..	96·31	96·39	96·82	97·36	97·18	96·65	96·14
Pol extraction	94·58	94·43	94·46	94·43	95·01	95·22	95·12
C.C.S. in cane	14·767	13·76	14·485	14·79	14·52	15·00	14·79
Coefficient of work	98·15	98·31	98·41	97·78	99·17	99·13	98·49

Crushing for the 1938 season commenced on 25th May and continued till 23rd December. The first mill to start was Macknade and the last to finish were Inkerman and Proserpine. The maximum harvesting period was 199 days at Inkerman and the minimum 80 days at Eagleby.

——	1932.	1933.	1934.	1935.	1936.	1937.	1938.
Crop days	3,276	5,130	4,382	4,296	4,809	4,497	4,822

Division of Mill Technology—continued.

Figures for 1938 Season.

——	Northern.	Central.	Southern.	Totals and Averages.
Tons cane crushed	2,275,927*	2,030,166*	1,035,992*	5,342,085*
Tons sugar made (94 n.t.)	328,301*	314,574*	135,261*	778,136*
Net titre	97·04	97·16	96·81	97·05
Tons of cane per ton 94 n.t. sugar	6·93*	6·45*	7·66*	6·87*
C.C.S. in cane	14·65	15·71	13·50	14·79
Co-efficient of work	98·46	98·63	96·71	98·49
Crushing rate	78·55	61·33	42·53	60·80
Lost time, per cent.	0·90	4·60	5·71	4·06
Fibre, per cent. cane	10·17	11·55	13·66	11·63
Pol, per cent. cane	15·74	16·70	14·62	15·84
First expressed juice—				
Brix	20·63	21·85	20·22	21·01
Purity	89·95	91·58	88·87	90·32
Clarified juice—				
Brix	16·92	16·46	15·39	16·34
Purity	90·07	90·77	88·07	89·83
Syrup—				
Brix	66·83	67·88	65·62	66·93
Purity	90·89	91·04	88·33	90·29
Last expressed juice—				
Purity	79·81	79·59	76·97	78·99
Clarified juice per 100 cane	97·07	107·75	101·40	102·13
Dilution, per cent. first expressed juice	21·93	32·75	31·38	28·58
Final bagasse—				
Pol	3·53	2·89	2·45	2·99
Dry substance	46·33	50·16	50·39	48·73
Pol extraction	94·56	95·71	95·15	95·12
Lost cane juice, per cent. fibre	51·14	35·70	33·33	40·12
Final molasses—				
Gallons per ton cane	3·39	3·72	4·18	3·54
Brix	85·14	87·03	88·12	86·74
Apparent purity	34·38	37·85	39·05	37·08
True purity	46·43	47·75	46·14	46·70
Reducing sugars	16·49	12·24	10·24	13·17
Final mud—				
Tons per 100 tons cane	2·80	3·16	3·00	2·99
Pol	3·19	2·01	2·51	2·55
Sugar—				
Pol	98·55	98·72	98·61	98·63
Reducing sugars	·36	·26	·20	·28
Ash	·23	·26	·32	·26
Moisture	·37	·30	·27	·32
Dilution indicator	34·26	30·61	24·12	30·48
Pol balance—				
Sugar (recovery)	87·50	88·72	85·46	87·52
Bagasse	5·44	4·29	4·85	4·88
Molasses	4·07	4·77	6·36	4·92
Mud	·57	·38	·52	·50
Undetermined	2·42	1·84	2·81	2·18
Boiling house efficiency	96·89	96·26	94·55	96·14
Fuel—				
B.T.U.'s 1,000s. per ton cane—				
Wood	29·88	95·95	200·00	100·43
Coal	..	17·39	2·63	7·61
Molasses	126·79	31·54	6·47	57·56
Bagasse	2,065·35	2,286·76	2,677·65	2,316·45
Total	2,222·02	2,431·64	2,886·75	2,482·05
Crop days	1,622*	1,822*	1,378*	4,822*

* All mills. Remainder except C.S.R., Pioneer, and Inkerman Mills.

Division of Mill Technology—continued.

Cane Milled and Sugar Yields, Season 1938.

Mill.	Tons Cane Crushed.	Tons 94 n.t. Sugar made.	Tons Cane per Ton 94 n.t. Sugar.	
			1938.	1937.
Mossman	98,361	14,729	6·678	6·373
Hambledon	213,715	31,515	6·781	6·889
Mulgrave	249,246	35,548	7·012	6·834
Babinda	272,730	37,832	7·209	7·010
Goondi	199,229	28,171	7·072	6·902
South Johnstone	265,508	37,853	7·014	6·765
Mourilyan	180,588	26,734	6·755	6·416
Tully	291,486	43,285	6·734	6·593
Victoria	255,544	37,368	6·839	6·709
Macknade	249,520	35,266	7·075	6·902
Total for Northern District ..	2,275,927	328,301	6·932	6·755
Invicta	95,603	15,253	6·268	6·426
Pioneer	184,892	29,235	6·324	6·256
Kalamia	213,331	34,193	6·239	6·319
Inkerman	261,220	39,115	6·678	6·511
Prosperine	195,016	30,612	6·371	6·481
Cattle Creek	84,394	12,844	6·571	6·537
Racecourse	196,588	29,996	6·554	6·620
Farleigh	162,295	24,638	6·587	6·584
North Eton	96,212	14,210	6·771	6·698
Marian	168,179	26,478	6·352	6·340
Pleystowe	187,460	29,224	6·415	6·418
Plane Creek	184,976	28,776	6·428	6·415
Total for Central District	2,030,166	314,574	6·454	6·443
Qunaba	83,310	10,439	7·981	7·877
Millaquin	158,399	20,622	7·680	7·710
Bingera	176,100	23,669	7·440	7·128
Fairymead	139,749	17,390	8·036	7·826
Gin Gin	50,125	5,982	8·379	8·357
Isis	215,206	28,834	7·464	7·574
Maryborough	33,027	4,259	7·755	7·536
Mount Bauple	51,388	6,519	7·883	7·850
Moreton	110,366	15,326	7·201	7·608
Rocky Point	15,668	1,941	8·072	8·052
Eagleby	2,654	280	9·479	11·585
Total for Southern District ..	1,035,992	135,261	7·659	7·603

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